TIME REQUIRED TO HEAT LARGE BUILDINGS

69

THE JOHN CRERAR MAY 18 1912

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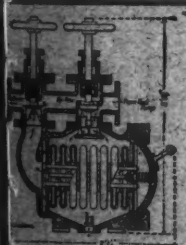

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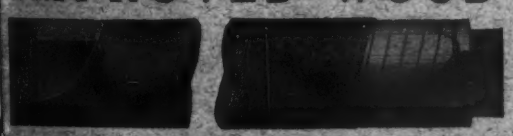

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THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK MAY, 1912

Ventilation Problems in Hospitals and Schools

I

BY W. GILMAN THOMPSON, M. D.

PROFESSOR OF MEDICINE, CORNELL UNIVERSITY MEDICAL COLLEGE IN NEW YORK CITY

One of the reasons for the disagreement which is so pronounced a feature of recent ventilation discussions is that very different types of ventilation may be made to subserve widely different purposes. It should be admitted at the outset that a mechanical ventilation "system," as it is termed, of some sort, is essential to make the atmosphere habitable at the bottom of a 100 ft. deep coal mine, in the stoke-room of an ocean steamer, or in the subterranean stories of the modern "skyscraper" building. Yet these are not places to which one would refer a tuberculous patient on account of the exceptional qualities of the air supplied, as might be inferred from the glowing accounts of enthusiasts for artificial ventilation systems who describe how the air supplied is filtered and sterilized and heated or cooled and hydrated or dehydrated, etc.

Two things should be admitted in this connection; namely, that an artificial system of some sort is essential to support life under such adverse conditions; and, secondly, that those working under such systems are, for the most part, strong, vigorous persons whose toleration of undesirable conditions is considerable.

WHEN MECHANICAL VENTILATION SYSTEMS ARE DESIRABLE

There are three other conditions under which some sort of a ventilation "system" becomes desirable:

1. Occasionally, to change the air in closed rooms where dust would be particularly undesirable and stagnant air would cause deterioration of certain stored products, as in large warehouses, the stock-rooms of large libraries, etc. In such places, which are only briefly occupied by human beings, the filtration, humidity and uniform temperature of the air are usually of much more importance than its gaseous composition.

2. In many factories, mills, chemical works, etc., harmful dusts, gases or fumes are evolved incident to the particular variety of manufacture, which must of necessity be removed by stronger air currents than can be depended upon from natural sources, and forced intake and outflow of air must be maintained by artificial means. The telephone "central" exchanges also present peculiar conditions requiring closed systems of ventilation, even in summer, on account of the serious damage to the delicate

electrical apparatus caused by the admission of dust.

3. There is the problem of heating and ventilating, with reasonable economy, large audience halls, such as theatres and churches, where window ventilation is obviously impracticable. It is this type of ventilation particularly which has given special impetus to the invention of elaborate "systems," but, unfortunately, the conclusions drawn from the results are often indiscriminately applied to totally different conditions. The persons composing the audience (presumably in health) breathe free outdoor air in going and coming, and a two or three hours' exposure to even a very undesirable atmosphere is tolerated without serious harm.

It is readily admitted that artificial ventilation systems are essential to meet such conditions as those above enumerated and with their details the present discussion is not further concerned.

Questions of vital interest, from the medical point of view arise, however, when attempts are made to apply the artificial systems under totally different conditions; namely, to the sick in hospitals, to the developing school child, and to those whose occupation necessitates long hours of sedentary work, especially brain work, as in offices in large buildings, public reading rooms, etc.

Among these, the two first-mentioned classes of persons are in urgent need of the very best kind of air whilh can be supplied and, unfortunately, too often they have the poorest. The hospital patient in a ward artificially ventilated and without open windows is subjected to an unvarying atmosphere (except as it varies in degrees of pollution) both day and night, often for weeks together, while his respiratory functions are often gravely impaired through anemia or disease of the lungs or heart.

The young child at school is called upon for exercise of the brain which urgently needs the best possible conditions of respiration and circulation. Moreover, the growing child is relatively much more sensitive than the adult to any deleterious influences that may affect these vital functions.

There are two methods of approaching the study of the fitness of the air supplied by any artificial system which may be crudely tabulated as follows:

METHODS OF STUDYING THE FITNESS OF THE AIR FOR RESPIRATION

The physiological method.	*The physical method.*
The use of the nose.	The thermostat and thermometer.
Blood pressure tests.	Cubic feet of air supplied per hour.
Metabolism tests; volume and composition of expired air.	Air analyses.
Symptom tests, as blood tests, headache, indigestion, dyspnœa, etc.	Hygrometry.

It will be seen at a glance that these two methods are diametrically opposite, for the one deals with the man, the other with the environment. Yet the former method has been so much neglected that few reliable data are obtainable concerning it, while the latter method is supported by volumes of highly impressive theoretical calculations.

How common it is for trustees about to erect a new hospital to accept the ventilation plans of the architect or mechanical engineer without as much as submitting them to the medical board for criticism. In a large hospital, recently erected in New York, the architects were allowed to install a most expensive closed ventilation system despite the protests of the medical board, with the result that, within a year, it had fallen into complete disuse, and the wards are ventilated through open windows, in the only rational way.

THE NOSE A GOOD GUIDE

The use of the nose, of a reasonably educated nose, as a means of detecting foul air, is entitled to far more respect than it generally commands,

and there are those whose faith in thermostats and hygrometers is so great that they are willing to scoff at Nature's instrument!

There is a line of trolley cars in New York much frequented for long-distance rides by the unwashed. According to the rules of the car company, the cars are adequately "ventilated," yet the nose easily distinguishes concentrated odors of many kinds—garlic, alcohol, sour stomach, fatty acids, sulphuretted hydrogen, catarrhal secretions, etc., which, of course, means simply that all the air which is breathed through the discriminating nose has already been breathed, and many times breathed, by someone else's lungs.

In another large municipal hospital, with which I was connected, a most elaborate closed ventilation system had been installed, with fans and exhausts and fancy regulating dampers and a huge tower in which the exhaust air was to be blown off aloft and scattered to the four winds. It cost many tens of thousands of dollars and, twenty years ago, we of the medical board knew no better than to endorse it. One day we began to use our noses. We discovered that certain odors developed in the wards in the early morning (for there were twenty-four bowels to be moved each morning in each ward) were distinctly noticeable hours after "the entire air of the ward had been changed repeatedly," according to the engineer's paper calculations. We ventured to open the windows for a few moments each day—the odors disappeared, but the ventilation system was thrown sadly out of gear.

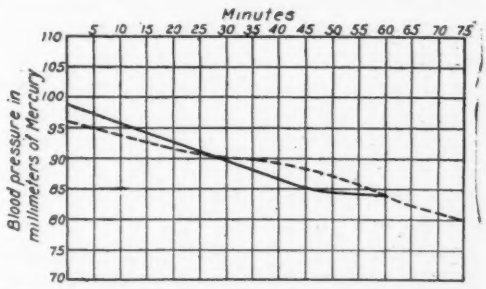
Somehow, the patients began to look better, recoveries were more prompt, anemia was less protracted; even the nurses noticed the improvement and had fewer headaches.

We grew bolder and, in some rooms, where it was possible to replace the closed "system" by steam heaters in front of the windows, we left the windows open all the time. Truly the nose is mightier than the thermostat!

Bad smells, of course, do not prove that air is irrespirable. Bad smells of a certain kind do prove indisputably that the air is not clean air, that it is not fresh and that it has been inside of someone's lungs already and is no more fit to "uplift" an invalid or nourish a growing child than food which has been in someone's mouth.

I. Blood Pressure Tests

A normal blood pressure of between 130 and 140 millimeters of mercury, as measured by compressing the brachial artery with special apparatus, is essential for perfect health. In a young child this normal pressure is about 100 mm. If the pressure falls much below this measure, say, below 100 mm. in the adult or 80 mm. in the child, the heart is enfeebled and respiration embarrassed. Very interesting experiments have been made lately by a number of observers, showing that in diseases such as pneumonia, pleurisy, etc., this pressure is markedly subnormal, whereas it promptly rises to normal when the patient is



TWO BLOOD PRESSURE TESTS ON PATIENTS WITH PNEUMONIA, FROM TIME OF GOING INDOORS FROM OPEN AIR (HOOBLER)

placed on a balcony or roof in the open air.

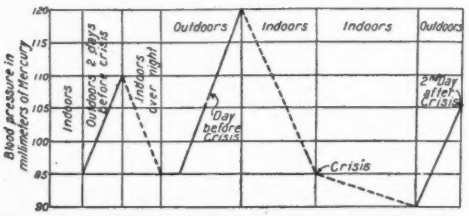
In the Presbyterian Hospital, New York, I have found a difference of 20 to 30 mm. in patients placed under these opposite conditions. In the same patient I have repeatedly measured a difference of 20 mm. on taking the patient to the open air, returning him to the ward, taking him out again, etc. In the fresh air, the cyanosis disappears, delirium subsides and many other symptoms promptly improve.

Dr. B. Raymond Hoobler, working in my clinic in the wards of Bellevue Hospital, New York, has charted a

series of blood-pressure experiments of this kind and, with his permission, some of them are reproduced herewith. They constitute a very convincing proof of the value of fresh air in distinction from canned air.

II. Metabolism Tests

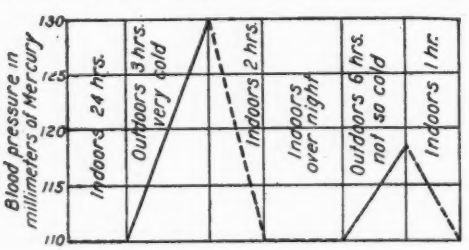
Tests of the rate of chemical interchange, *i. e.*, of the nutrition of the body, involving oxidation processes,



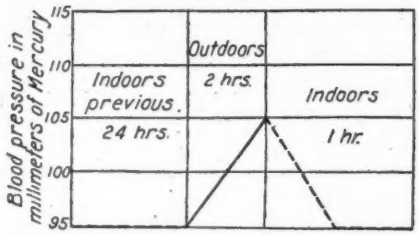
BLOOD PRESSURE TESTS ON PATIENTS SUFFERING FROM LOBAR PNEUMONIA (HOOBLER)
Continuous Line—outdoors.
Broken Line—indoors.

as modified by air of different sorts, have hitherto been much neglected, but with the perfection of modern calorimeter apparatus, as adapted to human respiration, such tests are being made and constitute a very convincing argument for the admission of fresh outdoor air to hospital patients.

In the case of a patient recently experimented upon for me by Drs. Hoobler and Burnham, in Bellevue Hospital, the following result was obtained. The patient was left overnight in a small room with window tightly closed. A pipe was then introduced through which the patient breathed fresh outdoor air while still remaining in the closed room. A brief supply of this air lasting only 15 minutes, made no appreciable difference, but after the window was



BLOOD PRESSURE TESTS ON PATIENT WITH PLEURISY AND EFFUSION, MODERATE TEMPERATURE (HOOBLER)
Continuous Line—outdoors.
Broken Line—indoors.

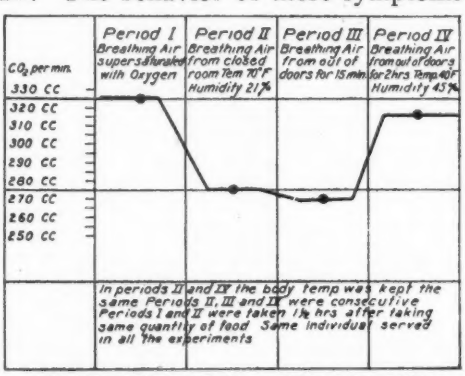


BLOOD PRESSURE TESTS ON PATIENT WITH INCIPIENT PULMONARY TUBERCULOSIS, SLIGHT AFTERNOON TEMPERATURE (HOOBLER)
Continuous Line—outdoors.
Broken Line—indoors.

left open for a couple of hours, all conditions surrounding the patient remaining otherwise the same, the rate of metabolism was increased to a very striking degree.

III. Symptom Tests

Under some conditions, with poor ventilation or stagnant air, a variety of symptoms obtain, such as anemia, headache, anorexia, etc., or, if they already exist from other causes, it is found to be impossible to procure betterment under the influence of poor air. The behavior of these symptoms


CO2 per min.
330 cc
320 cc
310 cc
300 cc
290 cc
280 cc
270 cc
260 cc
250 cc
Period I Breathing Air supersaturated with Oxygen
Period II Breathing Air from closed room Tem 70°F Humidity 21%
Period III Breathing Air from out of doors for 15 min.
Period IV Breathing Air from out of doors for 2 hrs Temp 40°F Humidity 45%
In periods II and IV the body temp was kept the same Periods II, III and IV were consecutive Periods I and II were taken 1½ hrs after taking same quantity of food Same individual served in all the experiments

METABOLISM TESTS WITH PATIENT BREATHING DIFFERENT QUALITIES OF AIR

constitutes far more convincing proof of the real conditions of the air than any theoretical computation of the number of cubic feet of air supplied per hour, hygrometric tests, etc.

IV. The CO_2 Test

The value of the carbon dioxide test to determine the fitness of air for breathing has been much questioned, especially where attempts are made to establish legislative standards for factory and school ventilation. Origi-

nally regarded as of prime importance, the test has been discarded by many upon the ground that the gas when present in reasonable quantity is not especially injurious. In fact, the present tendency is to substitute humidity tests for it exclusively. This is based upon a misconception of what the test reveals. In all metabolism experiments which include analyses of the expired air, the CO_2 estimation is a most valuable index. Moreover, the only source of CO_2, in an ill-ventilated room occupied by human beings (apart from that developed in certain trades) is the lungs. Hence, CO_2 accumulation in a ward or class-room means that the air has been breathed many times over by the occupants, and is, therefore, unclean air, just as water which has been bathed in many times is unclean.

Carbon dioxide and water are the ultimate elements of all the starches and sugars. The cereal eaten at breakfast is represented in the CO_2 of the afternoon exhalations from the lungs. The bread and potatoes eaten at dinner furnish the CO_2 of later expirations. CO_2 in the air of a room, therefore, when allowed to accumulate, is certain proof that the air is not being renewed fast enough to be fresh, and twice-breathed air has no "uplifting" power for the invalid or growing child. It is not the best air obtainable and they should have the best. In the same manner indican is not especially toxic, but its accumulation in the urine is an index of the formation of other waste products of the aromatic sulphuric acid series with which it is associated in metabolism.

When rightly interpreted, then, CO_2 estimation has distinct values as a ventilation test of room air. I published in the *Medical Record* of February 9, 1907, the results of some very careful CO_2 tests made for me in the wards of the Presbyterian Hospital by Dr. C. G. L. Wolf. We found that when fresh air on the hospital roof was practically normal (*i. e.*, 4.06 parts CO_2 per 10,000 volumes of air) that in the wards with the most complete closed ventilation system in full operation contained as much as 4.71 parts CO_2, and after twenty visitors and four nurses had spent one hour in the ward this content rose to 5.13 parts.

Immediately thereafter the ward windows were open for ten minutes only (thereby dislocating the heating and ventilation system of the entire hospital!) and the CO_2 content at once fell to 4.34 parts and, although on a cold December day, the ward temperature fell only 3° F. Does anyone believe that an increase of more than 20% of CO_2 produced by the visitors was not a reliable and definite indication that they had polluted the air for the patients?

V. Physical Tests

Physical tests of the air comprise the use of the thermometer, hygrometer and barometer, together with estimates of the cubic feet of air supplied and removed in a given time by mechanical means. With them are often combined automatic regulators, such as the thermostat. As these tests imply the use of instruments of precision, the results of which may be stated in terms of mathematical or graphic terms, they are naturally impressive to the minds of those unaccustomed to observe the more subtle and delicate phenomena of the human respiration and circulation.

Hence the advocates of the ventilation of hospitals and schools by "systems" which preclude the opening of windows adduce impressive figures to prove the correctness of their views. But, on the other hand, experiments are being gradually accumulated which tend to place direct observation of the respiratory and circulatory mechanism upon an equally definite basis.

Such experiments have heretofore been lacking, but the reference above made to the recording of blood pressure and the phenomena of metabolism would indicate that the argument for fresh air may be far more satistorily stated by the physiological than by the physical method. I am convinced that our present physical means of determining the properties of the air completely fail in recording

its most subtle, yet most important, property; namely, that which everyone recognizes for himself, the quality called "freshness."

It is not long since it was confidently taught that the chemical composition of the atmosphere was definitely established. Then argon and several other elements were discovered in it. It is not, therefore, unreasonable to believe that there are other physical properties than those which we have present means of recording.

Analogy may be adduced in several ways. For example, much of the air supplied by artificial systems has been greatly superheated. In one hospital, to my personal knowledge, it was superheated to 400° F. before being conveyed through long metal conduits to distant wards. Such air is canned air, or roasted air, and has no more "uplift" for the invalid or growing child than a meal of canned corn for the dyspeptic. One can live on canned food as the infant can live on sterilized milk, but such diets do not increase the resisting power of the organism against disease, and, if persisted in, may induce scurvy, although chemical and physical tests may fail to show exactly why this is.

Mineral waters, whether bathed in or drunk at their natural source, lose certain subtle properties when bottled and transported. Carbon dioxide artificially introduced into water for bathing is a poor imitation of such carbonic waters, for instance, as those of Nauheim.

Air which has been superheated and then moistened with steam or water spray in an artificial ventilation system is never quite the same as natural air.

(To be continued)

The Time Required to Heat Large Buildings to Normal Temperature

By Peter L. Tea, E. E.

I.

It is the purpose of this paper to develop a relation between the time, the temperature of the air in an interior, the volume, the various heat transmission coefficients of brick walls, glass of windows, etc., the air leakage coefficient and a quantity R, the significance of which will appear later. The results will be used to devise a method by which the amount of radiating surface required to heat a given interior in a given time can be calculated.

Sir Isaac Newton announced the formula for heat transmission, in terms of the cross section area A of the heat stream, the distance D between any two such cross section areas perpendicular to the heat stream and the temperature difference of the two areas. The coefficient K which enters as a factor depends upon the nature of the material.

The rate of heat flow, as Newton wrote it, is:

$$\frac{dH}{dt} = K\frac{A}{D}\left(T_1 - T_2\right) \quad \ldots\ldots\ldots\ldots (1)$$

which formula is used to-day in engineering problems. A more general form of (1) is

$$\frac{dH}{dt} = K\frac{dT}{dD}$$

The method of calculating heating surface developed by German heating engineers and used at present by the better class of heating engineers in this country, is based upon the actual calculation of the rate of heat transmission, in B. T. U. per hour, through exposed walls, windows, etc., in maintaining a given temperature inside the room, usually 70° F., with a given temperature outdoors, usually taken as 0° F. Values for the rate of heat transmission through walls of various

thickness, glass, etc., per square foot, for 70° F. difference in temperature, have been found experimentally. It is found that the rate of heat transmission is not exactly inversely proportional to the thickness, and that the temperature gradient is not linear, i. e.,

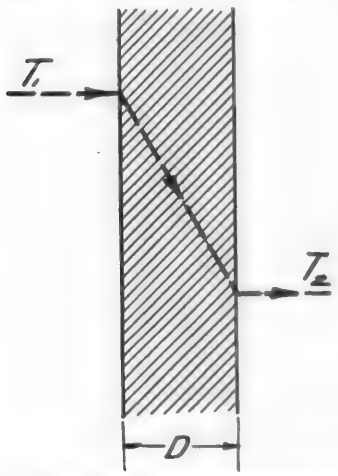


FIG. 1—HEAT TRANSMISSION THROUGH WALLS, ACCORDING TO NEWTON'S LAW

the temperature drop is not proportional to the distance of heat flow into the wall, as it is shown to be in Fig. 1, in accordance with Newton's law.*

For the special case of a good conductor of homogeneous material as a cylindrical rod, well lagged, the law of Newton would apply more accurately. The rate of heat flow is found by experiment to be very nearly proportional to the temperature difference maintained on the two sides of the wall.

Hence in our discussion later we are justified in adopting Newton's law in so far as it agrees with experiment; namely, in the form

$$\frac{dH}{dt} = k\,(T_1 - T_2)$$

where k includes the area of the surface as factor. The room temperature will not be uniform, being lower than the average 70° F. maintained near the walls and windows. But this difference is not large, as the air is in constant circulation and, besides, the calculations will be on the safe side, since the transmission will be slightly less than calculated.

The object of the heating engineer is to prescribe sufficient heating surface to heat up the interior to normal temperature in a reasonable time, with a little margin of heating surface above this for safety. The temperature regulator will then maintain the normal temperature desired, but it will be of no value if insufficient heating surface is installed.

AN ACTUAL CASE CONSIDERED

Let us apply the above method to an actual case and calculate the B. T. U. per hour which are necessary to just balance the transmission heat losses. The results will be used later.

In Fig. 2 the western exposure has a window area of $15 \times 8 = 120$ sq ft. The loss in heat per hour, when inside temperature is 70° F. and outside temperature is 0° F. is 85 B. T. U. per square foot of glass surface exposed. The heat loss is, therefore, $120 \times 85 = 10{,}200$ B. T. U. per hour. The wall area of the western exposure is $25 \times 15 - 120 = 255$ sq. ft. The walls are 12 in. thick, the coefficient is 23, hence

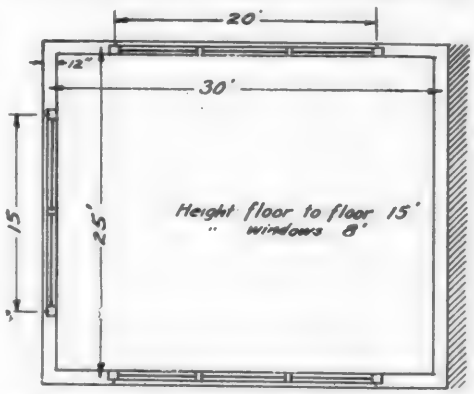


FIG. 2—PLAN OF ROOM USED IN CALCULATIONS

the number of B. T. U. transmitted per hour is $255 \times 23 = 5860$ B. T. U.

Table I, given below, is calculated in the same manner.

With steam at 2 lbs. pressure above atmosphere, temperature 220° F., there will be, for radiators single column up to 26 in. high, 250 B. T. U. per hour radiated to the air of the room if this air has a temperature of 70° F. The radiation will be greater

*See Dietz-Ventilations and Heitzungs Anlagen.

TABLE I

Room	Temp. Difference Deg. F.	Exposure		Surface Sq. Ft.	Coefficient	B.T.U. per Hour Transmitted
	70	N	Wall 12", 30x15—160	290	23	6,670
		N	Window 20x8	160	85	13,600
		W	Wall 12", 25x15—120	255	23	5,860
		W	Window, 15x8	120	85	10,200
		S	Wall 12", 30x15—160	290	23	6,670
		S	Window, 20x8	160	85	13,600
				Total...	.....	56,600

if the room temperature is less. With the room temperature at 70° F. and outside temperature 0° F., the radiating surface necessary to balance the transmission losses will be $\frac{56,600}{250} = 226$ sq. ft. However, with this radiating surface the room would never be heated to 70° if we start with a temperature lower than this.

For example, let us assume 0° F. in the room. The radiating surface will give more than 250 B. T. U. per hour per square foot, inasmuch as the temperature difference between steam in the radiator and the room air is 70° greater. The difference in temperature between the room air and outside air is less than 70° F. at start. Thus the transmission loss is less than 56,600 B. T. U. per hour.

The difference serves to heat up the room; but as the room temperature increases, the difference becomes smaller and smaller until it is zero at 70° F. The time rate of air temperature increase is smaller and smaller and the last increment of time is infinite. Thus the room temperature approaches 70° F. but never attains this value.

The time taken to reach a given temperature depends, among other things to be brought out later, upon the thermal capacity of the interior, i. e., upon the volume of air in the room, which includes the cold air which leaks in through doors and windows.

INTERNAL AIR VOLUME NOT USUALLY CONSIDERED IN FIGURING RADIATING SURFACE

In figuring the radiating surface no account is usually taken of the internal volume. It is customary to increase the various heat transmission figures by a percentage, 25 to 35%, depending upon the exposure. A well-known firm of consulting engineers in this country adopts the following percentages for the various exposures:

South exposure..... 25%
West exposure..... 35%
East exposure..... 30%
North exposure..... 35%

In a paper by Alfred R. Wolff on "The Heating of Large Buildings," the following values of percentages are given:

"Ten per cent. where the exposure is a northerly one and winds are to be counted on as important factors.

"Ten per cent. when the building is heated during the daytime only and the location of the building is not an exposed one.

"Thirty per cent. when the building is heated during the daytime only, and the building is exposed.

"Fifty per cent. when the building is heated during the winter months intermittently, with long intervals (say days or weeks) of non-heating."

Such values are rather arbitrary and no consideration of the volume or of the transmission coefficients and areas is taken into account. Good results are obtained for buildings and interiors of usual size. The above values were obtained by hard-bought experience for such cases.

A recognition, in a crude way, of the fact that volume enters in the question is seen from the practice of some heating engineers to bring up the total figure for radiating surface for the entire building proportional to the total volume, the factor of proportionality being obtained from previously designed heating installations in similar buildings, where previous guess work may not have been of the best. When such a condition is met, as, e. g., the spacious lower floors of a large office building, the practice is to add, arbitrarily, a large percentage, 100% or more (more to the north and west exposures than to the south and east, as a matter of form, not of calculation), to the heating surface over and above that required for covering the transmission when 70° F. inside temperature has been attained.

The percentage of increase is diminished gradually, and also arbitrarily, as the upper floors are reached. If the total heating surface is finally not found to tally per 100 cu. ft. of internal volume with other similar buildings, the plan is to increase all the figures by the required amount to make them tally. Thus they fall back upon the old, discarded method of figuring the heating surface by volume. A better distribution of the heating surface is obtained, however, than if figured throughout by volume.

The above procedure would not be necessary if we had a reasonably accurate method of calculating the percentage to be added in order to heat an interior of given volume and architecture to 70° F. from 0° F., or any other temperature, in any desired time.

So far as the writer knows there has not been developed a relation between the percentage to be added, the internal temperature, the time and the various transmission coefficients (the latter including the areas as factors). The results obtained by the use of such a formula would not be highly exact, they would be as accurate as the law of Newton is applicable to the heating of buildings and based upon experimental values of transmission figures. The results would, at least, be helpful in the guidance of judgment to an extent which remains for actual application and test of the time relation to actual interiors to decide.

We shall assume Newton's law in the form:

$$\frac{dH}{dt} = k(T_1 - T_2) \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

i. e., the rate of heat flow is proportional to the temperature difference and to the area. The quantity k includes the area as a factor.

The total rate of heat given off by the radiating surface, in B. T. U. per hour, is:

$$\frac{dH}{dt} = a(T_s - T_a) \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

where t = time in hours.
T_s = temperature of steam.
T_a = temperature of air of room.

a = coefficient for the total radiating surface, containing the area as a factor.

Similarly, the rate of heat transfer to the external air, through the various materials is:

$$b(T_a - T_o) + c(T_a - T_o) + \text{etc} = s(T_a - T_o) \quad \ldots\ldots\ldots\ldots\ldots (4)$$

where T_o = external temperature.
$s = (b + c + \ldots\ldots)$

The quantities b, c, etc., are the various transmission coefficients containing the areas as factors.

The excess heat; i. e., the difference between (3) and (4) serves to raise the room temperature.

$$a(T_s - T_a) - s(T_a - T_o) = Vsd\frac{dT_a}{dt} \quad \ldots (5)$$

Where V = internal volume of room.
s = specific heat of air.
d = density of air.

The density of the air we will assume constant, which is on the safe side, if taken at the value when room is cold. We will first consider no leakage of cold air in and warm air out to take place.

FIGURING A CASE WHERE NO INWARD OR OUTWARD LEAKAGE OF AIR TAKES PLACE

Assuming severe conditions, namely that $T_a = T_o$ for $t = o$ and integrating Equation (5)

$$t = Vsd \int_{T_o}^{T_a} \frac{dT_a}{a(T_s - T_a) - s(T_a - T_o)}$$

$$t = \frac{Vsd}{a+s} \log_e \frac{a(T_s - T_o)}{a(T_s - T_a) - s(T_a - T_o)} \quad \ldots(6)$$

If the heat given off by the radiating surface is barely sufficient, at the room temperature 70° F., to balance the transmission then from (5)

$$\triangle t \doteq \infty \text{ as } T_a \doteq 70° \text{ F.},$$

since, then,

$$a(T_s - T_a) - s(T_a - T_o) \doteq o$$

i. e., the temperature 70° will never be reached, though it will be approached nearer and nearer.

For every cu. ft. Vsd = 1 approximately.

WHEN THE AIR LEAKAGE IS PROPORTIONAL TO THE TIME

There is always leakage in a room not provided with positive ventilation, of cold air in and warm air out. This has a marked effect on the time required to heat to a desired temperature.

Assume the leakage proportional to the time. Representing the volume of the room by V, the volume of the air which has been heated in time t, not all of it, to the final temperature, will be:

$$V^1 = V(1 = \infty t) \quad \ldots(7)$$

where ∞ depends upon the leakage surface and represents the number of times per hour that the air of the room has been displaced.

The rate of leakage of warm air out is:

$$\frac{d(V \infty t)}{dt} \doteq V \infty \quad \ldots(8)$$

This is also the rate of cold air leakage into the room. The total rate of heat loss occasioned by the leakage is, therefore:

$$2 V \infty sd (T_a - T_o)$$

Our equation (5) becomes

$$a(T_s - T_a) - (s + 2V \infty sd)(T_a - T_o) = Vsd \frac{dT_a}{dt} \quad \ldots(9)$$

Integrating, we obtain an expression similar to (6):

$$t = \frac{Vsd}{a+s+2V \infty sd} \log_e \frac{a(T_s - T_o)}{a(T_s - T_a) - (s + 2V \infty sd)(T_a - T_o)} \quad \ldots(10)$$

Here, again, if $a(T_s - T_a)$ for $T_a = 70°$ F., is just sufficient to balance the transmission losses plus the leakage losses, $\Delta t \cdot \infty$ as $T_a \doteq 70°$.

THE VALUE OF ∞

The value of ∞ depends upon the total window perimeter and door area. The value to be assigned to ∞ must, however, in good part depend upon the judgment of the engineer as to the structure of the building. A cheap structure, as regards windows and casings, will necessitate a larger value of ∞ than a good first-class structure. An experimental determination of ∞ could be obtained by making CO_2 tests, as were made to determine the amount of leakage air into passenger cars not provided with ventilating apparatus, and also to find out how much air was exhausted from the car by ventilators operating on the aspirator principle:*

We will now simplify formulas (6) and (10), Let

$$R = \frac{a(T_s - T_a)}{s(T_a - T_o)} \quad \ldots(11)$$

The quantity R represents the number which, multiplied by the transmission loss through the walls, etc., gives the value of the B. T. U. per hour to be supplied. R represents numerically 1 plus the per cent., in decimal form, to be added above the transmission figures.

Equations (6) and (10) become, respectively,

$$t = \frac{Vsd}{a+s} \log_e \frac{R\left(\frac{T_s - T_o}{T_s - T_a}\right)}{R - 1} \quad \ldots(12)$$

and

$$t = \frac{Vsd}{a+s+2V \infty sd} \log_e \frac{R\left(\frac{T_s - T_o}{T_s - T_a}\right)}{R - 1 \frac{2Vs \infty d}{s}} \quad \ldots(13)$$

*Dudley—The Passenger Car Ventilating System of the Pennsylvania R. R. Co., 1904.
T. R. Crowder—The Study of Ventilation of Sleeping Cars.

Consider steam supplied at 4 lbs. above atmospheric pressure, temperature 225° F.; let $T_o = 0°$ F. and $T_a = 70°$ F., then

$$R\left(\frac{T_s - T_o}{T_s - T_a}\right) = R\frac{225}{155} = 1.45R \quad \ldots\ldots(14)$$

$$\text{Since } R = \frac{a(T_s - T_a)}{s(T_a - T_o)} = \frac{a\ 155}{s\ 70} = 2.22\frac{a}{s}$$

$$\therefore a = .45\,R\,s \quad \ldots\ldots\ldots\ldots\ldots\ldots(15)$$

Equations (12) and (13) become, respectively,

$$t = \frac{Vsd}{s(1+.45R)} \log_e \frac{1.45\,R}{R-1} \quad \ldots\ldots\ldots(16)$$

and

$$t = \frac{Vsd}{s(1+.45R)+2V\propto sd} \log_e \frac{1.45\,R}{R-1-\dfrac{2V\propto sd}{s}} \quad \ldots\ldots(17)$$

Equations (16) and (17) are in a form ready for use. They represent a relation between the desired quantity R to heat a given interior to 70° F. in any time t, starting with 0° F. internal temperature with outside temperature 0° F.

All the other quantities, except $\propto$ in (17) which must be assigned a value using judgment, are obtained or calculated from the dimensions given on the plans of the particular building and from values of transmission coefficients obtained by experiment.

(*To be Concluded*)

*The Time Element in Heating Apparatus**

By James A. Donnelly

The time element in heating apparatus may perhaps be compared to the starting load of an electric motor. It would require the determination of the thermal capacity of all parts of the apparatus, the building and its contents, and any air which may leak in during the period of initial heating.

It will thus be seen that there are a great many different factors to be considered, and that the theoretical figuring of the time required would be a very complicated problem. A recording thermometer placed at some suitable place within the building would, however, give the result with comparative accuracy. Of course, the outside temperature should be noted during the time of heating, and due allowance made for its increase or decrease.

Diagram 1 gives the record of a recording thermometer placed upon the top floor of a concrete construction building in Brooklyn. The fires had been banked during the previous night, and had been started up so that steam reached the top floor at 6 A. M. on Thursday, January 11, 1912. The temperature of this floor rose, as indicated, during the day, until 67° F. was reached at 6 P. M. The fires were then banked and the temperature dropped to 51° F. at 6 A. M. the following day. The temperature was then raised by the heating apparatus during this day to about the same as on the previous day. If the curve of the first day is extended, it would seem as if the temperature would have reached 69° F. about 2 A. M. If the curve is dropped from the opposite end, the indications are that it would have reached 69° F. about 2 A. M. the previous day. From this, it might be deduced that if the building were at zero, it would take about twenty-four

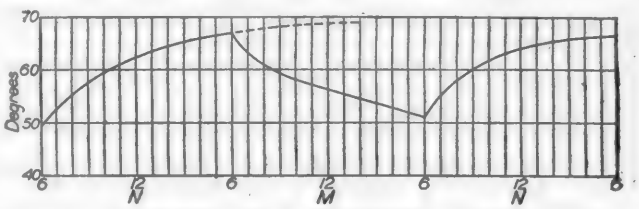


Diagram 1—Record of a Recording Thermometer on Top Floor of Concrete Building

*Read before the New York Chapter, American Society of Heating and Ventilating Engineers, March 12, 1912.

hours to have it reach 70° F. As the guarantee in this building was only for 65° F., it will be seen that the contractor's guarantee was fulfilled, though this temperature was not reached until 3 P. M. the first day and 2 P. M. the second day.

Diagram 2 is taken from the chart of a recording thermometer which was placed in a mill construction building, February 23 to 25, 1908, during a very cold spell of weather. It illustrates very nicely what often happens over Sunday in a factory building. This building contained a great deal of machinery, as well as metal in the course of manufacture, which would probably affect, to a considerable extent, both its heating and cooling curve.

The chart starts at 68° F. at 6 P. M. on Saturday, when steam was shut off the building. The rule of operation of this plant was to allow the building to drop to 50° F. before turning on steam. This point was reached at 6 A. M. on Sunday, when live steam was turned on, heating the building to about 59° F. at 11:30 A. M.

Steam was then shut off and the building cooled down to 48° F. at 11 P. M. Sunday, when steam was again turned on. It was kept on until 6 A. M. Monday, when it was shut off preparatory to starting the engines.

During the one-half hour that it was shut off, it will be seen that the temperature dropped about 2°. Exhaust steam was then put on and the temperature reached 66° F. at 12 o'clock noon. During the noon hour, while the engines were shut down, no live steam was used, and a drop of 4° is recorded. Exhaust steam being turned on again, the building reached a temperature of 68° F. at 6 P. M. Monday.

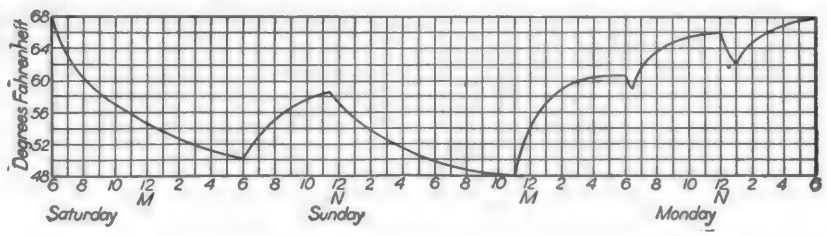


DIAGRAM 2—RECORD OF RECORDING THERMOMETER IN MILL CONSTRUCTION BUILDING

A METHOD OF FIGURING THE PROBLEM

The question of the time necessary to start up a boiler and complete apparatus can best be figured by considering the individual radiators first. The figuring of an individual radiator can in turn best be done by considering one in which the maximum opening of the supply valve is supposed or intended to be just sufficient for the normal condensation when the room is at 70° F., with the usual working pressure. With this opening and under this pressure, no steam is supposed to pass to the return, but only the water of condensation.

Considering the average cast-iron radiator as weighing 7 lbs. to the square foot, and its specific heat to be 0.13, the amount of steam required to heat the iron from a temperature of 30° F. to 220° F. would be 0.166 lbs. per square foot. If the rate of steam supply under normal condensation was 0.3 lbs. per square foot per hour, this, divided by 60, would give the normal rate of steam supply as 0.005 lbs. per minute. The time required to bring the radiator up to the temperature will be the initial condensation divided by the rate of supply minus the average condensation per square foot per minute while the radiator is heating.

As the room will rise somewhat in temperature during the time the radiators are heating, the average difference in temperature between the radiator and the room may be taken as about 182° F.

Figuring on this basis, the average condensation of the radiator while

heating will amount to about 0.00315 lbs. per square foot per minute. Applying the formula, $T = \frac{I}{R-C,}$ the result will be 90 minutes for the time required to bring the entire radiator up to temperature. By changing I and C for different temperature, the time required may be readily figured for any desired temperature.

CHART SHOWING RESULTS OF CALCULATIONS

Chart 3 has been figured in this manner and shows the time in minutes for heating up a radiator with a room temperature from 20° to 70° F.

The time required to withdraw the water of initial condensation may also be figured from the same formula if the outlet from the radiator is considered to be a fixed opening, just sufficient in size at the difference in pressure for which the apparatus is designed, to withdraw the water only and no steam. The time in this case will be just the same as in the case of the steam supply to the radiator.

The time required to heat up a radiator where the rate of steam supply is considered as two or three times the ordinary rate may easily be figured.

Further figuring along the same line will give the time required to start up an entire apparatus when coal is being burned at such a rate that the heat is being absorbed by the water circulation in a hot water apparatus, or by the evaporation of the water in a steam apparatus at the normal rate or at two or three times the normal rate. This will, of course, mean a greater rate of fuel consumption than that directly indicated, as the boiler or heater will naturally become less efficient when the fire is forced.

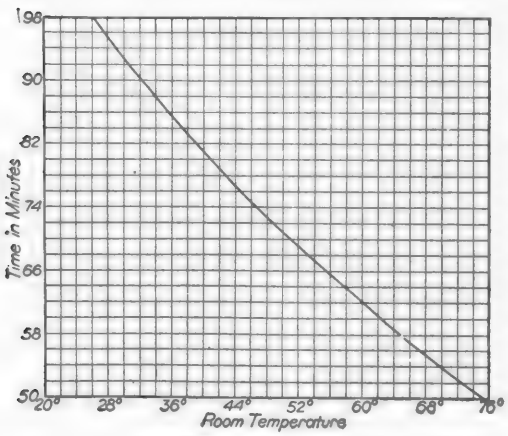


DIAGRAM 3—TIME TAKEN TO HEAT RADAITOR WITH VARYING ROOM TEMPERATURES

SIGNIFICANCE OF COOLING CURVES

The time element in regard to the cooling curve of buildings presents one other feature of considerable interest. The collection of a number of cooling curves from the same class of buildings would, all other things being equal, indicate the difference in the rate of air leakage. It might then be possible to specify the kind of construction which would be expected in a new building; as one which, when heated to 70° F. would not have more than a certain specific drop in temperature in a certain number of hours, when the outside temperature was at a particular point. This would be an indication of the value of weather stripping, in maintaining the temperature of a building when heat was shut off.

Perhaps the usual guarantee that an apparatus shall be of sufficient capacity to maintain a temperature of 70° F. in zero weather, in the case of a building which is continuously occupied, might be modified to a guarantee that the apparatus shall be capable of raising the temperature of the building from, for example, 50° to 70° F. in three hours, when the outside temperature is at zero, in the case of a building which is occupied intermittently.

Coal Bill Higher with Increased Humidity

With a higher humidity than has been customary in the past we can doubtless adopt a lower temperature, but not with a resulting saving in fuel, as has been stated in public prints. A simple calculation will demonstrate that approximately four times as much fuel is required to evaporate the water required to produce 50% relative humidity at 68° temperature in the schoolroom as is saved by reducing the room temperature 8°.—D. D. KIMBALL, *before the Heating Engineers' Society.*

Heating Large Concrete Factory Buildings

PLANT OF THE LEE TIRE AND RUBBER CO., CONSHOHOCKEN, PA.

One of the reasons for the general adoption of concrete construction for factory buildings is undoubtedly the possibility which it offers of greatly increasing the percentage of window space, as compared with brick and other forms of construction. The reinforced concrete structure serves as a frame only, the spaces between the columns in many cases being filled in entirely with glass surface.

On account of the greater heat loss through windows, both by radiation and by leakage, the heating design for such buildings must make proper provision for this additional loss.

As for the design of the power generating equipment of a modern factory, this is largely, and in some cases primarily, based upon the demands of the plant for heat, both for heating the buildings and for industrial processes. If a considerable percentage of exhaust steam can be utilized in heating or drying coils or in calendering rolls, vulcanizers, evaporators, dye tubs, cooking kettles, etc., power may be produced on the basis of a by-product. In other words, the cost of boiler equipment and the expense for fuel would necessarily be involved in any case to supply the demands for heat, and the production of power becomes an incident, involving no costs further than for engines and generators and for the care and attention which they must receive.

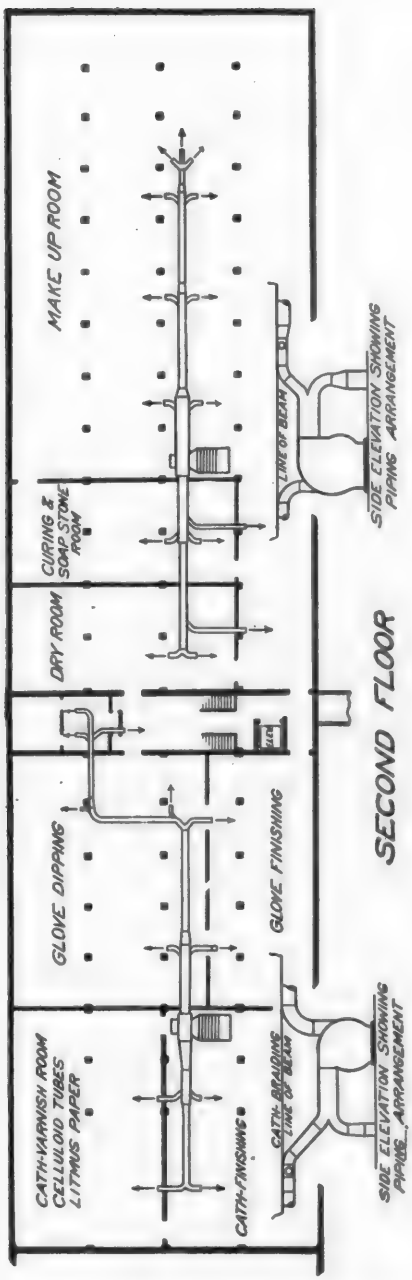
In many instances the demands for heat are so great that no exhaust steam is wasted at any period of the year, the exhaust steam being rather supplemented with live steam when there is an exceptional demand for heat, as in the winter. Where, on the other hand, the demand for exhaust heat during the winter about equals the output of the engine, in the summer there is generally a certain percentage of exhaust steam which must be allowed to escape to the atmosphere or be condensed.

In the rubber mill and rubber goods factory described herewith the demands for heat for warming the building and for vulcanizing, drying, etc., are so great that all of the exhaust is consumed during half of the year or more and only a small percentage escapes to the atmosphere even in the summer months. This is partly due to the fact that the lighting load is much less during the season when the least heat is required.

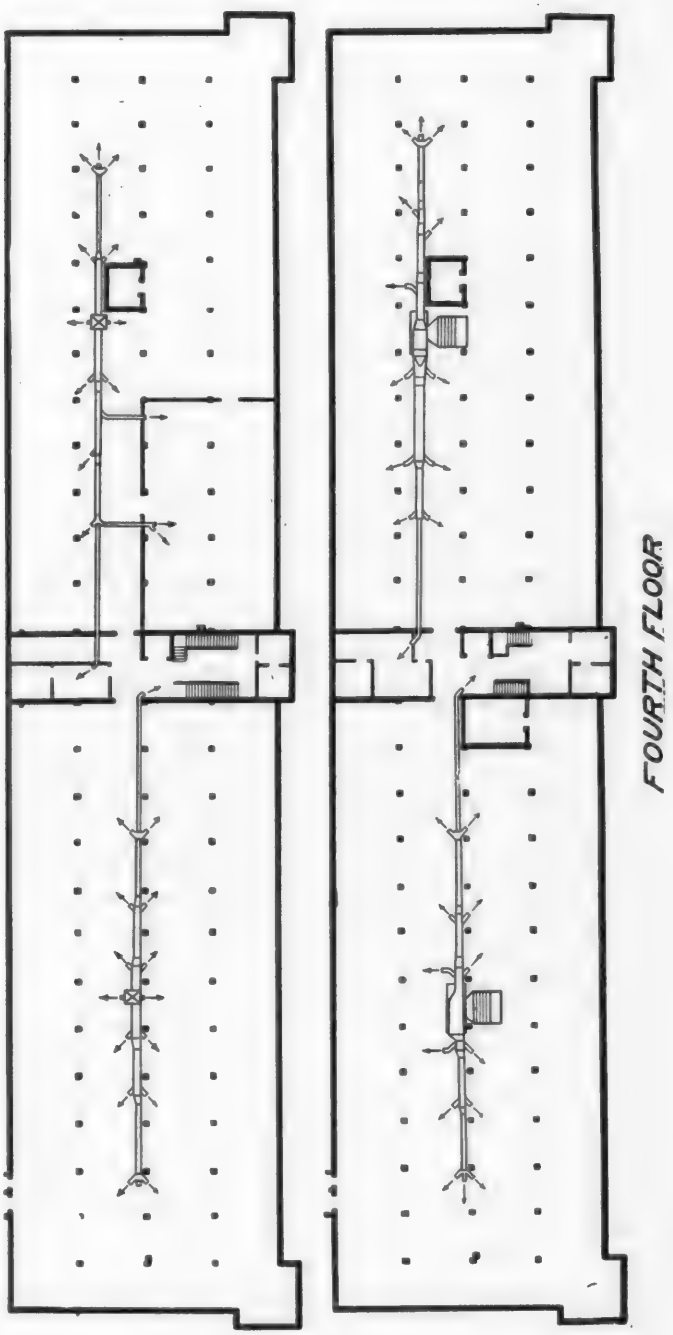
The plant described is that of the Lee Tire & Rubber Co., formerly the J. Ellwood Lee Co., of Conshohocken, Pa., manufacturers of rubber tires and inner tubes, trusses, etc. As may be inferred from the photographs presented herewith, the heating requirements were somewhat more exacting than ordinarily, due to the large amount of glass surface relative to total wall surface. For instance, in the large four-story building (the Hector Street Mill), which contains a total of 1,726,540 cu. ft., there are 44,300 sq. ft. of glass surface, as against only 6,328 sq. ft. of concrete wall and 29,800 sq. ft. of concrete roof. The maximum heat loss for this building was estimated at 4,605,000 B. T. U. per hour.

RUBBER MILL, LEE TIRE & RUBBER COMPANY

The heating and ventilating problems in this case is made more complicated still by the nature of the processes carried on in the buildings, in-



HOT BLAST HEATER AND OUTFIT ON SECOND FLOOR OF RUBBER MILL



THIRD FLOOR FOURTH FLOOR

HOT BLAST HEATER AND PIPING LAYOUTS, HECTOR STREET BUILDING

volving the handling of rubber dissolved in volatile liquids, which, during manufacturing and subsequent drying processes evaporate in large quantities into the atmosphere. For this reason, rather than because of the number of occupants, it was considered advisable to provide for changing the entire air contents of the main floors of the buildings every 18 min-

HOT BLAST HEATING APPARATUS, RIGHT HAND END SECTION, SECOND FLOOR OF RUBBER MILL, LEE TIRE & RUBBER COMPANY

utes, and of the basement every 22 minutes.

The large four-story Hector Street Mill is divided at the middle by a fire wall, and for this reason among others it was considered advisable to provide two heating equipments. These are exactly alike, each consisting of a Green hot blast heater outfit, located on the fourth floor and comprising a double discharge full housing fan, a Positiv-flo steam air heater and a horizontal engine. Each heater, which is of the Positiv-flo type, contains 80,240 lineal ft. of 1-in. pipe and the fan delivers 48,900 cu. ft. of air per minute against a pressure of ¾ oz. per square inch.

The air is taken from a fresh air connection extending to the roof and is heated to 140° F. In very cold weather, however, part of the air may be taken from inside the building and recirculated, the dimensions of the outfit being based on maintaining a temperature of 70° F. in the building with zero outside, recirculated air entering the heater at a mean temperature of approximately 50° F.

Another reason for dividing the heating equipment in two parts is found in the dimensions of the building, which is 400 ft. long by 85 ft. wide. Each of the four stories is 14 ft. high. Even as installed over ten tons of galvanized iron were required in the duct work for this building. A large vertical duct leads the air from the fan to the several floors, where, as may be seen, horizontal branched ducts run along the ceilings with outlet nozzles on either side to discharge the air down against the floor, thereby delivering the air into the space occupied by the workmen.

The Rubber Mill is a much smaller building, having a total length of 330 ft., a width of 82 ft., and two stories, each 14 ft. high, making the total contents 658,560 cu. ft. This building is also divided by a fire wall into two parts, but the two parts are not equal and the heating apparatuses installed are, therefore, of different sizes. The right hand side of the building, having a total contents of 416,640 cu. ft., a total glass surface of 11,074 sq. ft., a total wall surface of 1,582 sq. ft., and a roof area of 14,880 sq. ft., was estimated to require 1,038,000 B. T. U. per hour, and, with an 18-minutes' change, to require 23,160 cu. ft. of air per minute. Using exhaust steam in the heater, 3,850 actual lineal feet of 1-in. pipe were allotted in the hot blast heater for heating the air from 50° to 140° F. which was considered sufficient to maintain a temperature of 70° F. in zero weather. The similar quantities for the left hand end of the build-

ing are: contents 241,920 cu. ft.; glass surface, 6,276 sq. ft.; wall surface, 896 sq. ft.; maximum heat loss, 467,000 B. T. U. per hour. The air required for an 18-minute air change is 13,440 cu. ft. per minute, and to heat the air from 50° to 140° F. a hot blast heating outfit consisting of a heater of 2,250 actual lineal feet of 1-in. pipe and a three-quarter housing fan, driven by a vertical engine were installed. The galvanized iron work for this building weighed three tons.

All heating and ventilating and other heat requirements throughout the building are, as far as possible, met by the use of exhaust steam. The exhaust from all units is gathered into one exhaust main, which leads to a Cochrane open heater, in the separator of which the steam is purified of oil before passing to the exhaust steam distribution system. A reducing valve provides for furnishing live steam when the supply of exhaust is insufficient. The small engines driving the fans also exhaust through separators directly into the corresponding hot blast heaters. Exhaust steam is also used for preventing freezing of the water in the fire protection tank, and also for some nearby hot beds belonging to the proprietors of the establishment.

Most of the radiators, calendars, etc., are fitted with automatic air valves and the air and water are delivered by the vacuum pump into a tank about 10 ft. above the heater. The hot blast heaters, however, are located at a sufficient height to return the condensate by gravity, the drop being sufficient to overcome any vacuum which may be carried on the system.

HOT BLAST HEATING APPARATUS, LEFT END OF FOURTH FLOOR, HECTOR STREET BUILDING, LEE TIRE & RUBBER CO.

Due to the careful utilization and conservation of all condensate and drips, very little make-up water is required for the operation of the plant, the little needed being taken from an artesian well. After heating and treating with soda ash in the heater the boiler feed water is pumped, at a temperature corresponding to the back pressure or vacuum in the heater, through a Green economizer of 6,000 sq. ft. of heating surface into the boilers.

The stack of this plant is 150 ft. high, giving a draft of 2 in., and serves not only for the boilers but also to dispose of the sulphuric acid fumes from the rubbed vulcanizers.

AIR COOLED IN SUMMER

During the summer, advantage is taken of the possibility of using the hot blast heaters for cooling the air, water from an artesian well being circulated through the tubes of the heater and overflowing into the reservoir. This type of heater lends itself exceptionally well to this service, since the flow is positive from inlet to outlet. The pipes are arranged horizontally between two vertical headers and it is possible to examine the individual tubes and to remove scale or other accumulations from the interiors of the pipes after taking off the covers from the headers.

During the recent exceptionally cold weather, the heating of the buildings has been most satisfactory. The design of the plant as a whole is due to Mr. Broadnax, consulting engineer, New York, while the hot blast heating equipment was designed and supplied by the Green Fuel Co., of Matteawan, N. Y.

Ventilation as Observed by a City Health Department

By M. T. Stevens

CHIEF SANITARY ENGINEER, DEPARTMENT OF HEALTH AND SANITATION, SEATTLE, WASH.

An architect or an engineer lays out a plan for a heating and ventilating system, and though he may be honest in thinking that he is covering the matter of ventilation at the time he is figuring out his plan for heating, because he knows that authorities agree upon the amount of fresh air which should enter a room in order to keep the air within a reasonable degree of purity, we have found, in many instances, that he successfully accomplishes the object of an even temperature, but entirely forgets the matter of the ventilation.

Take one specific instance in which our department had occasion to investigate, which was a large public building in Seattle in which many people congregate daily. Numerous complaints were received at the office about foul air in this building, and we were finally requested to make an investigation. After a long and careful survey it was found that the temperature in most of the rooms was what might be termed good, but upon measuring the air currents it was proved that there was less than half enough fresh air entering the room to keep the air within a reasonable sanitary limit of vitiation; and with further investigation it was discovered that the ducts for delivering the fresh air to the rooms were laid out in curves, rather than straight lines, which resulted in a cutting down of the velocity by "skin friction." The factor of friction seemed to have been entirely forgotten by the person who laid out the system.

Again, it was found that the outlet for foul air was located almost directly below the fresh air inlet. The outlets were connected to another system of fans for the purpose of exhausting the foul air from the room. These fans had a capacity of exhausting power almost twice as great as the fan which supplied fresh air to the room. The result was what may be termed an enormous "short circuit" from inlet to outlet, thus defeating the entire function of the ventilating system, and also cutting down the efficiency of the heating plant by creating a condition of low pressure in the room, caused by the greater capacity of the exhaust fans.

Another disagreeable feature of this condition of things, which was very noticeable in these rooms, was the fact that persons sitting still could wear their outdoor garments without discomfort, and that they were always conscious of floor drafts as well as any atmospheric change outside. This, no doubt, was due to the lower pressure in the room, which permitted outside air to leak in around windows and doors. A properly proportioned system would require just the opposite condition, and the air would have a tendency to be forced out around windows and doors, thus preventing any inflow of cold air.

Chemical analyses of the air in different rooms of this building were made with the following results:

Accepting CO_2 as an index to vitiation, one room with 140 occupants showed, in one part of the room: 3 ft. above floor, 11.45 parts in 10,000 parts of CO_2; 12 ft. above floor, 16.41 parts in 10,000 parts of CO_2; 7 ft. above floor, 14.47 parts in 10,000 parts of CO_2. The temperature of this room was 66° F. Relative humidity, 55½%.

Another room of 74 occupants showed: 3 ft. above floor, 18.56 parts in 10,000; 3 ft. above floor, 19.06 parts in 10,000; 6 ft. above floor, 15.48 parts in 10,000; showing a remarkable condition of vitiation. The temperature was 66° F. Relative humidity, 55%.

In two rooms large, direct steam

radiators had been installed in addition to the regular heating system. Upon inquiry it was learned that it was impossible to heat the rooms without them. The cause for this state of affairs was found to be in the fact that an outlet of greater capacity than the inlet was located directly below the inlet, thus causing a considerable short circuit of the air supposed to heat and ventilate these rooms, and the occupants found it necessary to maintain a temperature of about 72° F. in order to overcome the draughts from around the doors and windows. Not only was the purpose of the regular heating and ventilating systems defeated, but the cost was increased.

Dishonest contractors who have knowingly installed inefficient heating and ventilating systems. have been known, when the test of the system was to be made for the benefit of the owners and architects, to have men stationed in the plenum chamber for the purpose of juggling the valves in such a way that an entirely inefficient system might appear to conform with the specifications.

It might be well to say right here, with due respect to all honest contractors, that all ventilating and heating systems should be tested by competent, unbiased engineers, without any aid from the contractor, thus insuring an honest test of the system, and to this no honest contractor should object.

ANOTHER EXPERIENCE

Let us cite another experience, in connection with the public schools of Seattle, and I wish to say that the conditions found here do not differ from those that may be found in the schools of any city of the United States, and I am confident that a widespread investigation would bear me out in this statement.

Using CO_2 as an index of vitiation, a great many samples of air were taken from different parts of our school rooms, and it was found that the amounts of CO_2 per 10,000 parts varied greatly. The velocity of the air entering the rooms was measured and it was found in most instances that there was more air delivered than was actually necessary in order to maintain a proper condition; and yet the CO_2 content was abnormally high. We adjusted the speed of the fan and regulated the valves so that the proper amount of air should be delivered to each room, and again tested the air, and found that the CO_2 content did not materially change.

Evidently, something was wrong. Upon thinking the matter over, it was decided that the cause of this condition of things was an improper distribution of the air about the room. It was therefore suggested that a deflector be made according to a description which was given the engineer in charge of such work in the schools, and he had such a deflector made, with several vanes radiating so as to divert the air currents to different parts of the room.

After the apparatus was installed the school was again visited and it was found that the tinsmith who made the deflector, being of an artistic temperament, had introduced curves in the vanes and made them parallel to each other, contrary to the instructions given him. It was easily seen what the effect would be, and upon inquiry of the teacher in one room we were told that she could notice a vastly higher temperature in one part of the room, which bore out our suspicions, as did further tests of the air for the CO_2 content.

The vanes of the deflector should be flat and should radiate to the different parts of the room, and must not be parallel, but at different angles, so that the air currents will be sure to reach every part of the room.

USE OF CHARTS SUGGESTED

It was then suggested that charts be made, giving the angle of the vanes for these divertors, depending upon the location of the fresh-air inlet in the room. That is, the charts would not be the same for every room, as the fresh-air inlet is sometimes located about the center of a wall and sometimes at one side, either way, of the center.

The method in which these charts were calculated is thus:

Lay out a plan of the room in which the divertor is to be used, upon a piece of paper, to scale. Then locate the fresh-air inlet in its proper place upon the plan, divide the face into six or seven equal spaces, then draw a line diagonally from corner to corner of the room, and divide this line into as many spaces as the number shown on inlet opening. Connect points together by drawing lines between the two. The angle of the vanes for the divertor can be measured upon the plan. The vane at the smallest angle should be curved so as not to cut down the velocity of the air current too abruptly. These charts may be numbered, and as one is needed for a room it may be ordered by number and chart submitted, thus avoiding mistakes.

BAD CONDITIONS FOUND IN MOVING PICTURE SHOWS

There have been very few complaints to the Seattle Department of Health and Sanitation from patrons of these places, and yet we have made air analyses from every moving picture place in Seattle and found that very few gave good results from a CO_2 standard. The range of CO_2 results from all shows in the city was from 6.26 parts in 10,000 to as high as 34.5 parts in 10,000. At the time these analyses were made there were only six show places which showed below 10 parts in 10,000, only 17 below 15 parts, and the balance went from 15 parts to 34. However, there were only three which went above 20 parts. In some of these places fans were installed, but poorly placed, and others were not working at all.

To show what a fan, properly placed and of the proper capacity will do, we will cite one particular instance. Upon first analysis the air was found to contain 13.44 parts of CO_2 in 10,000 parts. After a 20-in., direct current, direct connected disc fan was installed and in operation, another analysis was made, which showed only 6.80 parts in 10,000, which is almost ideal and really better than the average school or theatre in any city. Most of these shows are located in places which were built for store purposes and have very low ceilings, and have absolutely no way of ventilating except as the air leaks in around doors or windows, which, of course, has absolutely no considerable influence upon the air in the room.

The greatest difficulty met with in ventilating these places is that of preventing drafts, due principally to the low ceilings. Therefore, any law or ordinance made to control these places should be very carefully handled so that it would not only be a question of a given quantity of fresh air of a stated temperature, but the method of delivering the air, as to velocity, should be given some attention. This could be done by a system of ducts arranged in the ceiling to openings in different parts. With caps to properly diffuse the air, the foul air could then be taken off under the chairs in the floor. In this way a large quantity of fresh air at very low velocity could be delivered, and thus objectionable drafts could be avoided. The number of inlets or outlets could be fixed by the number of chairs.

This brings us back to what was said before, that it is not alone necessary to supply a given quantity of air, but the method of distribution must enter as a most important feature of every plan. In the writer's opinion, the subject of ventilating the moving picture show is of vast importance and should be taken up and carefully handled by every Health Department all over the United States. The mistake of being too hasty in passing laws on this subject should not be made. Careful consideration of the matter is bound to give good results.

UNIQUE METHOD FOR TESTING VENTILATION OF STREET CARS

The proper ventilation of street cars has not been given the amount of consideration its importance demands. The Department of Health and Sanitation of Seattle has recently made many analyses of air from street

cars, observed under different conditions as to the number of monitor deck windows were open, and has almost come to the conclusion that the ventilation of the cars is practically in control of the operator in charge, by simply adjusting the ventilating sash along the monitor deck.

It is our purpose in the near future to endeavor to discover the amount of ventilation, as to quantity of air which passes through these monitor deck windows while the car is traveling at different rates of speed. This, we think, will be done by having a box constructed to represent that portion of a street car, and in connection with a fan, run at different velocities, we expect to be able to determine the result very satisfactorily.

The Effect of Water Pressure in Preventing the Transmission of Heat from Steam Through Surfaces

By O. M. Row

A paper on the above subject, presented by O. M. Row at the last meeting of the Institution of Heating and Ventilating Engineers had reference to the use of steam in heating the water supply for a public building. The author stated that he had been perplexed at times to note a variable efficiency in the heat transmission from the team to the water and had come to the conclusion that the head pressure on the water side seriously affected the heat transmission from the team.

Low pressure steam had ordinarily been used for this purpose, probably through fear of putting too great a tax on the strength of the apparatus. This, concludes the author, is a false policy. According to the tests which he conducted, the heating efficiency of steam heated surface goes up in proportion to the steam pressure, and high pressure steam also means a much more compact apparatus.

In his paper the author described at length some tests he had made in which a very steady hydraulic load was maintained on the water side. The tests commenced with 100 lbs. steam pressure and 5 lbs. water pressure. The water pressure was then gradually increased to 100 lbs. and conditions noted at intervals during the increase. This series of tests showed that as the head pressure of the water was increased the efficiency of the steam surface in transmitting the heat units fell off considerably.

Another series of tests was made with steam at 50 lbs. pressure, starting with a water pressure of 5 lbs. and running up to 50 lbs. This produced a similar curve up to the point of 50 lbs. water pressure. From that point up to 100 lbs. water pressure, there seemed to be little effect one way or the other. A third series of tests was made with steam at 25 lbs. pressure and water from 5 lbs. to 50 lbs. pressure.

The following tables give the steam pressures in pounds per square inch on the water side, the water inlet and outlet temperatures, the time taken to fill the tank containing 25 gal. of water, and the equivalent rate in gallons per hour.

As a result of the tests, it was found that the heat transmission followed a curve until the point was

TABLE SHOWING THE EFFICIENCY OF HEATING SURFACE AT VARIOUS STEAM PRESSURES.

Steam pressure in lbs. per square inch....	5	10	15	20	25	30	40
Quantity of water raised from 50° to 180° F. in gallons per square foot of Row's tube heating surface per hour...	35	42	56	62	80	93	103

RESULTS OF TESTS SHOWING EFFECT ON HEAT TRANSMISSION OF DIFFERENT STEAM PRESSURES AND WATER HEADS

Steam Pressure in Lbs. Sq. In. on Cover	Pressure in Lbs. per Sq. In., Water	Water Inlet Temp., Deg. F.	Water Outlet Temp., Deg. F.	Time Taken to Fill Tank	Gallons per Hour
				Min. Sec.	
100 LBS. STEAM PRESSURE					
100	5	80	180	7 0	214
100	10	80	180	8 30	176.5
100	15	80	180	9 50	153
100	20	80	180	10 0	150
100	35	80	180	13 45	109
100	50	80	180	16 0	93.7
100	65	80	180	17 45	84.5
100	80	80	180	18 10	82.5
100	100	80	180	18 15	82
50 LBS. STEAM PRESSURE					
50	5	80	180	12 10	123
50	10	80	180	16 0	93.7
50	15	80	180	16 45	89.5
50	20	80	180	18 0	83.4
50	35	80	180	27 0	55.5
50	50	80	180	28 0	53.5
50	65	80	180	28 0	53.5
50	80	80	180	26 15	56.6
50	100	80	180	28 0	53.5
25 LBS. STEAM PRESSURE					
25	5	80	180	32 50	45.7
25	15	80	180	40 30	37.0
25	25	80	180	44 0	34.0
25	50	80	180	44 30	33.8

reached where the water pressure became equal to the steam pressure. After that, any rise in the water pressure did not seem to produce any decrease in the heat transmission.

For instance, in the 100 lbs. steam pressure test, with a head of 5 lbs. per square inch on the water side, the rate in gallons per hour of water heated to 180° F. was 214. This rate fell rapidly as the water pressure was increased until, at 100 lbs. water pressure, the curve merged into a horizontal line. Moreover, the decrease was very rapid at the beginning, becoming gradually less as the water pressure approached 100 lbs.

As to the 50 lbs. steam pressure tests, with the exception of one result, namely, the one at 80 lbs. water pressure, the curve became approximately a horizontal line at the point of 50 lbs. water pressure.

In the third case, that of the 25 lbs. steam pressure tests, the curve gradually fell until 25 lbs. water pressure was reached, after which a horizontal line was maintained. From this test it would seem that the decrease in the rate of heat transmission ceased when the water pressure equalled the steam pressure.

The author's theory, based on the results of the tests, is that, with a low water pressure and a high steam pressure, minute steam bubbles are formed on the water side of

the tubes which aid the transmission of heat from the steam to the water. For he states as his assumption that, as the point at which the decrease in efficiency ceased was the point where the possibility ceased of the steam within the tube producing steam bubbles on the outside of the tube, therefore the decrease in efficiency was due to a gradual reduction, as the pressure increased on the water side, of that proportion of the tube which was capable of producing on its surface, on the water side, minute steam bubbles. This, the author added, must be taken as a theory capable of clearer light on further investigation.

Trouble With a Swimming Pool Heating Apparatus

An interesting experience in connection with the use of a hot water boiler for heating a swimming pool was reported by Edward S. Mobley at the recent meeting of the heating engineers' society. In the case in question the water was heated by a hot water circulating boiler set at one end of the pool. The water was circulated around to the other end of the pool and entered the pool near the top, returning to the boiler from the end of the pool nearest the boiler. The top of the boiler was about 1 ft. below the water level in the pool.

In about 2½ years from the time of the installation, the circulating pipe began to leak and Mr. Mobley was called in to repair it. The owners wanted him to connect the supply pipe to the swimming pool near the same end near which the heater is located, so as to save the tearing up of the cement pavement surrounding the pool, and then carry the pipe down near the bottom of the pool, with outlets at different points along the bottom of the pool. Mr. Mobley refused to do it that way, knowing that it would give trouble, but another party undertook to do it that way, running the pipe along the bottom to the center of the pool, grading it up from the starting point and letting the water out in a series of jets.

The next day the owners had to buy a new boiler. They did so and started up again. Now they have still another boiler to buy and the trouble has not yet been remedied. Mr. Mobley stated it as his opinion that there will continue to be trouble until the pipe is removed or an air valve be inserted at the high point.

Unique Cold Air Shield for Direct Radiators

One solution of the problem of securing fresh air with a simple form of heating apparatus was described by Edward F. Stevens before the American Hospital Association and is shown in the accompanying illustration. The air is brought in directly behind the radiator and a removable shield is placed as

COLD AIR SHIELD FOR DIRECT RADIATOR

shown to deflect the air current upward. On a still day this shield might not be necessary, but in the case of a heavy wind, especially with a low outside temperature, the shield is found useful in counteracting any air currents that pass the radiator before becoming heated. As arranged the shield may be easily removed for cleaning purposes.

National Conference on Industrial Hygiene

Papers on "Temperature and Humidity in Factories," by Royce W. Gilbert, Boston; "Air Impurities, Dust, Fumes, and Gases," by Charles Baskerville, College of the City of New York; "Effects of Air Conditions upon Health of Workers," by George M. Price, medical director of the Factory Investigating Commission of New York State, and on "Psychological Factors in Human Efficiency," by Hugo Munsterberg, of Harvard University, will be read at the forthcoming Second National Conference on Industrial Diseases, to be held in Atlantic City, N. J., June 3-5, 1912. The conference is under the auspices of the American Association for Labor Legislation. A feature of the meeting will be an industrial hygiene exhibit.

Central Supply Association has moved its headquarters in Chicago to Suite 1915, City Hall Square Building, 139 North Clark St., an announcement to that effect having been received from the secretary, Paul P. Blatchford.

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IN RESPONSE to a query expressed in these columns recently as to how long it takes to heat a building from a given outside temperature to 70° F., we are enabled to present in this issue two articles on this subject, one giving some practical observations and the other treating the problem from a theoretical standpoint and written, it may be added, in direct response to our query. As soon as additional observations, which are now being made, are at hand, it will be possible to make a very interesting comparison by checking the theoretical results with those actually obtained in specific cases.

ANOTHER problem of deep interest to heating engineers is that connected with the air pressures in tall buildings, especially those containing "stair cages," as the French call them, or other large spaces extending more or less towards the top of the building. This problem, generally known as a study of the "neutral zone," is treated in a most interesting manner in a paper read before the French society of heating engineers. The paper has been especially translated for THE HEATING AND VENTILATING MAGAZINE and will appear in the next (June) issue.

BLOOD pressure tests, as an indication of the fitness of the air in which the subject is living, has a sound of novelty to most heating engineers and is easily the striking feature of Dr. W. Gilman Thompson's discussion of "Ventilation Problems in Hospitals and Schools," which commences in this issue. Moreover, the fact that he and others in similar capacities, have the veto power over the use of expensive and elaborate heating and ventilation systems reveals a situation of the most pressing importance in its possible bearing upon the future of the industry.

Dr. Thompson has a happy faculty of being able to sum up and express tersely the arguments of those opposed to present methods of heating and ventilation and in this respect alone, if in no other, his paper would well serve as a working basis on which the engineering and medical professions could get together and formulate a further course of procedure.

OWING to the severity of the past winter, in which the heating season was prolonged, in many sections, through the month of April, arrangements have been made for publishing the weather charts for April, instead of concluding them with the March records, as has been our custom.

MECHANICAL EQUIPMENT

The Art of Vacuum Cleaning

III.

A PRACTICAL DISCUSSION OF PRESENT METHODS AND APPLIANCES

By Austin H. Hart

(Continued from April issue)

Testing

PIPING

Piping should be tested with an air pressure equal to 15 in. of vacuum immediately after erection, and the completed system should hold 15 in. of vacuum with all outlets closed. During the test under vacuum no agitation should take place in the wet tank or in the event wet tank is not used, a glass "U" tube filled with water should be placed in the air line near pump, for the purpose.

SEPARATORS

Separators should be tested by scattering evenly over a given floor space a compound consisting of 50% bolted wheat flour, 40% fine sand and 10% powdered charcoal. This should be picked up by the cleaning appliance, and the operation repeated four times. If the reciprocating type of exhauster is used, it is to be opened, and any dust found in the pump should be sufficient ground for the rejection of the separator or separators. If the fan or rotary type is used, the exhaust pipe beyond the exhauster should be disconnected and a large bag of fine cheese-cloth dampened with water and wrung out should be securely fastened over the end of the exhaust pipe during the operation of the system, as specified above, and at the end of the test, the inside of the bag should show no indication of dust having passed the separators.

EXHAUSTERS

An outlet should be provided in the vacuum main previous to the same being connected with the first separator, this outlet having sufficient area to permit the flow of air through the same during the operation of the exhauster, without maintaining any vacuum in the separator. A gate valve with a galvanized iron funnel should be attached to this outlet. With the balance of the system closed tight, the gate valve should be adjusted so that the vacuum in the separator will show 6 in., 9 in., 12 in., and the exhauster should be capable of handling 40 cu. ft. of free air or air at atmospheric pressure per each appliance to be used (that is, if the system is to operate two appliances, its capacity should be 80 cu. ft. of free air, and so on up), while at the same time maintaining 12 in. of vacuum in the first separator, or 50 cu. ft. of free air while maintaining 9 in. of vacuum or 60 cu. ft. of free air while maintaining 6 in. of vacuum. The volume of air handled should be determined by an anemometer or Pitot tube or other test, made in the mouth of the funnel.

The above mentioned method of testing has been adopted by the U. S. Government engineers and is, without doubt, the only proper and scientific method of finding the efficiency of any vacuum system, and whether the exhauster meets the requirements of the specifications.

INCORRECT METHOD

Comparative tests of various vacuum systems have recently been made by well-known architects and engineers by noting the amount of

vacuum maintained at the exhauster and the amount of vacuum maintained at the ends of different lengths and sizes of hose used by these various systems, together with readings as to the amount of horse-power employed by such exhausters at the time. A test of this character in no way shows the relative merits of various systems or the efficiency of their exhausters. It merely shows the loss of vacuum due to friction of the air in passing through different lengths and sizes of pipe and hose and proves the well-known fact that the larger the pipe and hose, the less the frictional loss.

This leaves the main question still to be determined, namely, as to the amount of free air or air at atmospheric pressure that the exhauster handles while maintaining the desired vacuum to be used in cleaning and the horse-power consumed in this work. There is no question but that the larger the piping and hose, the higher will be the vacuum shown at an open orifice of less diameter than the hose at the end of said hose, in relation to the vacuum maintained at the exhauster. However, when an appliance is attached to a hose, whether the hose be 1 or 2 in. in diameter and this appliance is more or less sealed during the operation of cleaning a carpet or rug, the vacuum at the end of the hose is increased and will more nearly equal the vacuum maintained at the exhauster, regardless of the hose diameter. Therefore, the advantages of the large hose are not so appreciable when an appliance is being used as it would appear when the hose is open to the atmosphere.

The size of pipe and hose can always be determined by the architect or engineer and so stated in the specifications, and such size pipe and hose can be used in connection with any first-class vacuum system. However, the architect or engineer in determining these sizes, should carefully consider the cost of installation and maintenance of large pipe and hose; also the inconvenience of handling large hose in connection with the cleaning appliances. Also whether the advantages of less pipe friction in the large hose, when an appliance is actually in operation will warrant the use of such hose with the attending inconvenience and expense, especially in view of the fact that years of experience have proven that a high vacuum with fair size piping and 1 in. hose produces the best results, on account of the fact that we have a very high velocity in the passage of the air through the pipes, which materially lessens the tendency for the dust and dirt to settle in horizontal runs and cause obstructions there, as well as in the risers and turns of the piping system.

The claim has been made that high vacuum is destructive to carpets, rugs and fabrics to be cleaned. This is a falsity in that the rush of air in cleaning is up through the nap of the carpet and in the same direction as the nap extends, so when the cleaning tool is being passed over carpet, rug or fabric, this rapid inrush of air into the cleaning appliance on a high vacuum, as heretofore explained, has a tendency to break the suction of the appliance on the surface of such carpet, rug or fabric and will not pull as hard on such surface as where a low vacuum is maintained and a very limited amount of air passes into the appliance.

AUTOMATIC UNLOADER

Every exhauster should have an unloading device able to automatically control the amount of air displaced by the exhauster, and at no time should more air be displaced than is required for the appliances that are in use. For instance, an exhauster has a capacity of operating five sweepers, each of 40 cu. ft. of free air displacement, while maintaining 12 in. vacuum. Only two sweepers are being used, in which event the machine will merely displace 80 cu. ft. of free air and the

120 cu. ft. of free air, which would ordinarily be displaced by the exhauster, should be by-passed or arrangements made to reduce the displacement of the exhauster, thereby using only such power as is necessary to displace the air that is used by the appliance in operation, the unloader saving a very considerable amount in power consumption, especially in large installations. The old method was to use the ordinary relief valve on the exhauster. This prevented the vacuum increasing when some of the appliances were not in operation, but the exhauster at all times displaced air to its full capacity and there was no saving in the power consumption.

SCRUBBING AND DISINFECTING

There are now systems so constructed that floors may be scrubbed at the same time that dust removing appliances are being used. The water for scrubbing may be taken from the water service of the building. Scrubbing appliances are provided so that this water may be run on the floors and taken up by vacuum by the mere pressing of a lever on the handle of the appliance. The amount of water used on the floor and the time that it remains is under the control of the operator doing the scrubbing.

With these systems one line of hose and appliance is used in scrubbing and disinfecting so that the apparatus used in scrubbing is as convenient for handling as that used in carpet sweeping.

There are systems that not only distribute the water, but perfectly dry the floors without streaking and, due to the construction of their separator, are able to collect dust and dirt with one or more sweepers while using the scrubbing device, an automatic pump on the side of the vacuum exhauster automatically discharges into the sewer the water collected during the process of scrubbing, maintaining a given level of water in the separating chamber.

APPLIANCES

Limited space will not permit us to go into this subject in detail, but the prospective purchaser cannot be too careful in investigating the appliances that are offered with the various systems. One should consider the relative merits of these appliances and their adaptability to the uses they are to be put to in the particular installation.

We submit herewith a general form of specification for a vacuum cleaning installation, which we feel will meet every requirement to securing a first-class installation and one which will give the various manufacturers of vacuum cleaning systems an opportunity to offer a proposal in fair competition.

SPECIFICATIONS FOR VACUUM CLEANING SYSTEMS

1. *General Description.*—This contract is to include the furnishing and installing of a complete vacuum cleaning system for the removal of dust and dirt from rugs, carpets, floors, stairs, walls and other fixtures and furnishings throughout the building, and for conveying said dust and dirt to suitable receptacles located in the basement where indicated, and is to include all necessary cleaning tools; hose, piping, separators, exhausters, motor, engine, etc., to make a complete working system.

2. The system may be designed to operate under either a high vacuum, a medium vacuum, as hereinafter described.

3. *Air Exhausting Plant.*—Furnish and erect where shown on drawing, an improved air exhausting apparatus of ample capacity to operate the system, without overload, under the test conditions hereinafter specified.

4. *Capacity.*—The plant to consist of one unit of capacity to operate —— cleaning tools at one time on the following basis: High vacuum system, 40 cu. ft. of free air a minute per cleaning tool while maintaining 12 in. vacuum; medium vacuum system, 50 cu. ft. of free air a minute per cleaning tool while maintaining 9 in. vacuum.

5. *Exhauster.*—The exhauster is to be of approved construction and may be either a reciprocating or a rotary type pump, having a positive displacement, or a multi-stage centrifugal fan-type exhauster.

6. *Reciprocating Type.*—The reciprocating exhauster shall be so designed that the clearance shall be reduced to the minimum and exhauster so constructed that it will handle the volume of air required at the specified vacuum with the least possible loss, and the valves are to operate smoothly and noiselessly.

7. *Rotary Type.*—The rotary exhauster shall be so designed and constructed that access may be had to all moving and wearing parts.

8. *Centrifugal Fan Type.*—The centrifugal fan exhauster to be so proportioned and constructed as to handle the volume of air required at the specified vacuum with the least possible loss. The housing shall be of cast iron, made in sections, with hand holes for access to all interior moving parts. The housing must be air tight.

9. Approved devices must be provided for proper lubrication.

10. *Bearings.*—The journal boxes shall be plain bearings, lined with anti-friction metal, and must be of such proportion as to operate at maximum speed and load without undue heating.

11. *Base Plate Foundation, etc.*—Provide suitable base plate to rigidly support the exhaust and its motor or engine as a unit.

12. Provide suitable foundation of brick or concrete, to which the base plate shall be firmly anchored. Foundation of such a height as to bring the working parts of the machine at the most convenient level for operating purposes.

13. *Speed.*—The reciprocating pump shall operate at an average piston speed not exceeding 200 ft. per minute, except when said pump is provided with mechanically moved valves, it shall operate at an average piston speed not exceeding 350 ft. per minute, the rotary pump not exceeding 1,100 ft. average peripheral velocity of tips of blades per minute, and the peripheral speed of the centrifugal fans not to exceed 15,000 ft. per minute, when running under specified full-load conditions.

14. *Drive.*—The exhauster shall be driven by an electric motor or steam engine which may be direct connected to the exhauster shaft or be operated with a metal link belt of the noiseless type. Chain and gearing is to be of ample size and strength for their work, and must run without undue noise or wear. Means shall be provided to take up the slack of the chain belt.

15. *Finish.*—The air exhauster and motor or engine and the base plate shall be finished in a first class manner, filled, rubbed down and painted at least one coat at the shop and after installation shall receive two more coats, finishing tint to be as directed.

16. *Electric Motor.*—Motor to be of such size that when operating under test conditions same will not be under less than three-fourths nor more than full-load conditions.

Motor to be of standard make, approved by the Architect or Engineer.

17. *Steam-Driven Piston Vacuum Pump.*—If the steam-driven piston vacuum pump is accepted, it is to consist of an approved steam-driven horizontal or vertical cylinder, double-acting, of the crank and flywheel type with air-drawing cylinder mounted tandem, and of ample capacity to perform the work required by the vacuum machine.

18. The machine to be equipped with approved safety suction and discharge air valves, approved automatic steam and speed governor, and all mountings necessary implied to place the machine in perfect working order.

19. This equipment shall be provided with an approved base-plate extending under the entire frame and cylinders. Base-plate to be extra heavy and substantial in construction, having proper depressions for collecting waste oil, having 1½ in. outlets, properly tapped and protected with removable brass screens for catching dirt, etc.

STEAM-DRIVEN ROTARY VACUUM PUMP.

20. If a steam driven rotary vacuum pump is accepted, it shall be of the capacity hereinbefore specified for the piston pump. The engine and pump are to be mounted on one continuous extra heavy cast iron sub-base.

The engine is to be an improved type and make, simple vertical engine, direct connected to the pump.

21. The rotary vacuum pump, as selected, must be of an approved type and make, cycloidal pump with impellers, each working on a separate axis or a continuous action rotary vacuum pump.

22. *Dust Separators.*—There must be provided one or more separators located on the air lines in basement.

23. Where two separators are used, the separator first receiving the dirt is to be a dry separator and the connections and interior arrangement of the dry separator must be such that no part of same will receive the direct impact of the dust, and said separator must intercept not less than 90% of the dust entering same.

24. No cloth, bags or metal screens of any description will be permitted in this separator.

25. The separator receiving the air and remaining dust from above described separator may be either a wet or dry separator and must be so constructed as to positively intercept all dust passing the first separator.

26. If wet separator only is used, means must be provided in same or as an attachment thereto, which will positively mix the air and water, intercepting all dust and dirt entering the separator and thoroughly break up all bubbles and positively separate the water and dust from the air and prevent it entering the pump.

27. Wet separator (if used) must be connected to the water supply main as indicated, and waste pipe from separator

must be run and properly connected with drain pipe.

28. *Automatic Control.*—Suitable means shall be provided in connection with the motor of reciprocating or rotary exhauster that will maintain the vacuum in the separators within the limits of the machine at a point found to be most desirable, irrespective of the number of sweepers in operation.

29. *Drawings.*—Contractor will be required to submit after award of contract drawings, showing exhauster, motor, separators, connections and type of control, in detail, for approval. Said drawings must be approved by the architect before any of the work is installed.

30. *Vacuum Required.*—The system is to be suitable for one of the following described types of apparatus, viz.: For a high vacuum apparatus designed to operate with a maintained vacuum of 12 in. of mercury at the dry separator or wet separator where only one separator is used. For a medium vacuum apparatus designed to operate with a maintained vacuum of 9 in. of mercury at the dry separator or wet separator, where only one separator is used.

31. *Piping System.*—The piping system is to be installed as indicated and noted on the drawing. The pipe sizes given on the drawing are to be followed for either a high vacuum system or a medium vacuum system. No increase or decrease to these pipe sizes will be permitted.

32. *Pipes.*—All pipes conveying air to be standard wrought iron, screw jointed pipe, and is to be smooth inside, free from dents, kinks, fins or burrs. Ends of pipe reamed to the full inside diameter and beveled. Bent pipe to use used in mains where so indicated on drawing.

33. *Fittings.*—All fittings to be Dunham or long sweep sanitary type, free from blow-holes or other defects; smooth castings in all cases.

Where necessary to avoid projections of floor beams, etc., risers are to be offset at angle not greater than 45°.

Horizontal overhead pipes to be supported with substantial pipe hangers spaced not more than 10 ft. apart.

Where exposed pipes pass through walls or floors of finished rooms they must be fitted with cast iron nickel-plated plates.

34. *Clean-out Plugs.*—Brass screw-jointed clean-out plugs are to be provided in lines, at all turns and at the base of each riser.

35. *Exhaust Connection.*—Exhaust pipe from the exhaust is to be run up to the basement ceiling and along same into and to top of vent shaft.

36. *Outlets.*—The following number of outlets are to be provided ———.

Sweeper outlets to be provided with hinged or screw covers or caps with rubber gaskets.

37. *Cleaning Tools, etc.*—The following cleaning tools are to be furnished for each set:

Renovator not less than 12 in. or more than 15 in. wide, for cleaning carpets.

Renovator not less than 12 in. or more than 15 in. wide, for cleaning bare floors.

Brush renovator not less than 12 in. or more than 15 in. wide, for cleaning walls.

Dusting brush renovator not less than 4 in. or more than 6 in. for cleaning relief work.

Upholstery cleaner not less than 4 in. or more than 6 in. wide, for cleaning upholstery furniture.

Extension tube about 5 ft. long.

45° handle for floor cleaning.

38. The renovator for carpets, bare floors, walls and relief work to be arranged with adjustable swivel joint so that same can be set at an angle with stem of about 45° for regular use and at an angle of 80° for use under or back of furniture and other similar places.

39. There shall be furnished one 50 ft. length of 1-in. hose for each set of cleaning appliances.

40. The hose to be best quality rubber hose, reinforced in best manner to absolutely prevent collapse at highest vacuum obtainable with the exhauster furnished and to prevent collapse if stepped on. Weight of hose to be not over 16 oz. per linear foot.

41. Couplings for hose to be either screw, slip or bayonet-lock type with smooth bore of practically same diameter as inside of hose.

42. *Tests.*—Contractor is to make tests hereinafter described and must furnish the labor necessary in connection with operating the exhauster, etc., to make said tests.

43. *Capacity Tests.*—On completion of the system the exhauster is to be operated with all hose connections closed and under this condition there shall be no agitation in the water in wet tank or in a glass enclosed water seal, placed in the air line near exhauster in event no wet tank is used. This test is to determine the tightness of the pipe lnes, outlets, etc.

A connection fitted with a gate valve is to be provided by the contractor in air line near inlet to separator making an anemometer or Pitot tube test of capacity of the exhauster. All hose connections are to be closed and an anemometer or Pitot tube placed in funnel in connection with the gate valve, and reading taken of vacuum maintained and amount of air at atmospheric pressure handled by exhauster.

44. A high vacuum system must maintain 12 in. of vacuum while displacing not less than 40 cu. ft. of free air per minute per cleaning tool; a medium vacuum system, 9 in. of vacuum and 50 cu. ft. of free air per minute.

45. *Efficiency Tests.*—The power required to operate the motor or engine

under above conditions shall not exceed 3 H. P. per cleaning tool.

46. *Test of Separators.*—At an outlet to be selected, the contractor is to furnish and spread on the floor covering an area of approximately 200 sq. ft., 20 lbs. of dry, sharp sand, that will pass a No. 50 mesh screen, mixed with 10 lbs. of fine wheat flour and 10 lbs. of fine powdered charcoal.

47. To outlet selected is to be attached 50 ft. of hose of the size required by system used, with a floor cleaning tool, and the floor surface covered with sand, flour and charoal are to be cleaned with the apparatus by operator provided by the contractor until all the sand, flour and charcoal spread on the floor has been taken up, after which the apparatus is to be shut down, and the sand, flour and charcoal in day separators is to be taken out and operation of taking up is to be repeated three times, making four times that dust is to be handled by the apparatus, or if wet separator only is used, then four times the above amount of material is to be provided and taken up by the cleaning tool.

48. If pump type of exhauster is used, it is to be opened and any dust found in the pump will be sufficient ground for rejection of the apparatus. If fan type exhauster is used, the exhaust pipe beyond the second separator and the fan is to be disconnected before test and a large bag of fine cheese cloth dampened with water and wrung out, is to be furnished by the contractor and securely fastened over the end of the exhaust pipe during operation of the plant, as specified above, and at the end of test the inside of bag must show no indications of dust having passed separators.

49. And dust found in the bag after the test will be sufficient ground for rejection of the separators.

Current Heating and Ventilating Literature

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that have appeared in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

DUST EXTRACTION SYSTEM

Mechanical Appliances for Dust Extraction in Cotton Mills. H. M. Crawford. Deals with vacuum system of extracting now used in Lancashire cotton mills. 2800 w. 20 figs. Cassier's—Feb., 1912. 40c.

FACTORIES

Home Office Regulations of Humidity in Weaving Sheds. Reprint of regulations under the Factory Workshops Act, to come into force April 1, 1912. 2000 w. Mech. Engr.—Jan. 19,1912. 40c.

FRICTION LOSS IN PIPES

Diagrams for Determining Friction Loss in New Cast Iron Pipe. Abstract of paper by Prof. A. N. Talbot and M. L. Enger, before the Illinois Water Supply Association. 1000 w. 3 figs. Eng. & Contr.—Jan. 31, 1912, 20c.

Notes on Revised Coefficients of Friction for Pipes. Jos. N. Le Conte. Gives values obtained from the experiments of Williams and Hazen for use in the equation commonly employed in pipe computations. 1400 w. Jl. El. Power & Gas—Jan. 27, 1912. 20c.

FLOW IN PIPES

Flow of Air Blast in Pipes. C. Reignier. Describes method of determining the mean velocity of flow, with examples from a test. 4600 w. 7 figs. Tech. Moderne—Feb. 15, 1912. 60c.

STEAM POWER PLANTS

Hebrew Infant Asylum Power Plant. Warren O. Rogers. Describes example of a small modern isolated power plant; equipment consists of air washing and heating apparatus, with automatic control of the hot and cold air supply; also the necessary steam and power generating units. 2300 w. 5 figs. Power—Feb. 27, 1912. 20c.

VACUUM CLEANERS

The Vacuum Cleaner in the Shop. Ethan Viall. Illustrates and describes three installations for different purposes. 600 w. Am. Mach.—Jan. 25, 1912. 20c.

VENTILATION

The Influence of Ozone in Ventilation. Leonard Hill and Martin Flack. Discusses the supposed existence of organic chemical poisons in air, showing them to be usually harmless, and their effect due to smell. Reports experiments and considers the general principles of heating and ventilating. Discussion. 6500 w. Jour. Soc. of Art—Feb. 9, 1912. 40c.

Occupational Diseases

Dr. George W. Webster, president of the Illinois State Board of Health, spoke before the Chicago Medical Society recently on the diseases due to peculiar conditions of employment. He grouped these diseases into five principal classes:

1. Diseases due to gases, vapors and high temperatures.
2. Diseases due to increased or decreased atmospheric pressures.
3. Diseases due to metallic poisons, dusts or fumes.
4. Diseases due to organic or inorganic due and heated atmosphere.
5. Diseases due to fatigue.

As to the detrimental effects of certain trades, European investigations into industrial sickness and accident experience would seem to warrant the theoretical assumption that among an industrial population of ages 15 years and over of

both sexes, but in the proportion of two males to one female, and engaged in miscellaneous trades and not exclusively in the hazardous trades, there will occur fifty cases of sickness per hundred persons employed per annum. Of this number, five cases will be the result of industrial accidents. The mortality rate will be approximately ten per thousand per annum.

There are twenty-eight industries in Illinois in which lead-poisoning is a factor. The lead trades are much more dangerous here than in England and in Germany, owing to the fact that in those countries there are laws in regard to this industry, while in this country we have, until very recently, had none. He quoted Dr. Alice Hamilton as saying that "there were 578 cases of lead-poisoning in Illinois in the records of physicians of three years." There has been an average of about one case a day reported by the State factory inspectors since the Illinois law went into effect on July 1, 1911.

The mortality from metallic dust, mineral dust, vegetable fiber dust, animal and mixed fiber dust from consumption of employees in this group of occupations is from 50% to 100% higher at all ages than would be normally expected.

Legal Decisions

Architect's Right to Select Particular Covering

A contract for the erection of a power, electric and heating plant for a county provided that the work should be done and the materials furnished to the satisfaction of the architect and engineer. In an action on the contract, it appeared that trouble arose over the furnishing "sectional covering . . . air cell, class A," required by the specifications. The plaintiffs provided a kind of covering which, they contended, complied with this description, and the architect claimed that it did not. On refusal by the plaintiffs to substitute, he gave notice to remove the materials, and subsequently to terminate the contract. The case was sent to the auditor, who found the facts for the plaintiffs. It was thereafter tried, on his report and additional evidence, before a justice of the superior court, who found generally for the defendant. On appeal the court said that the weight of the evidence, including the auditor's report, seemed strongly to support the view that the plaintiffs complied with the terms of the contract, and that the architect was wholly without justification in fact for the action he took. But under the rule that the findings of fact of a trial court can only be set aside when they have no foundation in evidence, the appellate court could not disturb the general finding for the defendant. The evidence was not quite so conclusive as to enable it to say that no finding was reasonably possible except that the architect acted unreasonably, capriciously, arbitrarily, willfully or fraudulently. Under the terms of the contract, so long as he acted honestly and with reasonable efficiency his action was binding upon the parties. It might be that the covering furnished by the plaintiffs was not inferior in quality or otherwise to that of a particular manufacture selected by the architect, and yet a rejection of it might be within the legal right of the architect and engineer acting in good faith, and not whimsically, even though somewhat ignorantly or mistakenly.—Evans vs. Middlesex County, Massachusetts Supreme Court.

McCreery Patent on Air Purifying Apparatus Upheld by U. S. Circuit Court of Appeals

McCreery Engineering Co., Detroit, Mich., has won its suit against the Massachusetts Fan Co., for a patent infringement for apparatus for tempering and purifying air. The suit was decided in its favor by the United States Circuit Court of Appeals, to which the McCreery Company appealed after the lower court had rendered a decision favorable to the Massachusetts Fan Company. In the opinion of the appeal court, as stated by Justice Brown, the question turned on the point as to whether the invention was on sale for more than two years prior to the application for the patent. The claim had been made by the defendants and supported by the lower court that at least two contracts had been made for the construction of the apparatus described in 1905, or more than two years before the patent application was filed. The Circuit Court of Appeals held that there was a failure of proof that the apparatus of the patent in suit had been actually constructed at any time prior to March 5, 1906. There was proof, the court held, of an executory contract for future construction, but there was nothing sufficient to show that the invention had ever been reduced to practice prior to March 5, 1906, which was two years before the application date. Quoting from a previous decision, the court states that drawings and verbal description of an invention, however completely they may show conception, are insufficient to establish reduction to practice unless filed as an application for a patent, when they are accepted as a constructive reduction to practice. A mere contract to construct from plans and to deliver in future a machine or manufacture not

proven to have been previously completed, falls short of proof that the machine or invention was "on sale."

The judgment of the Circuit Court was, therefore, reversed.

National Association of Jobbers of Wrought Iron Pipe and Fittings

Several features of modern trade methods, including resale prices, the selling of wrought pipe, brass pipe, fittings and valves, and radiation were discussed at the recent annual meeting of the National Association of Jobbers of Wrought Iron Pipe and Fittings, which was held at Atlantic City, N. J., April 22-23, 1912. In his address President Charles H. Simmons stated, in connection with the matter of resale prices that, "we have encouraged resale prices and succeeded in getting some manufacturers to adopt them. When resale prices have been fixed by manufacturers with a profitable differential to jobbers and the said resale price has been abused by the jobber, the manufacturer has been assisted by us in stopping this abuse, which is pernicious and to the disadvantage of those who are doing their best to uphold the resale prices, and which, if persisted in, would be likely to result in abandonment of this method of sale by the manufacturer. I think we can safely say that we have demonstrated to the manufacturers that the work of our association, which at one time they considered a menace, has proven instead to be in its development of great benefit and assistance to them in many ways."

In regard to the changes in list prices, he stated that the association has endeavored to keep its members posted as to contemplated changes in list prices. Members have also been advised of the practice of manufacturers with regard to standard, thickness, weights and dimensions of fittings and valves and also standards of threads used by manufacturers, and the request has been made to the manufacturers that they work toward a uniformity in the manufacture of their fittings, especially with regard to standardization of threads.

President Simmons also spoke of the valuable information obtainable by members from the secretary's office relating to warehousing, handling and shipping of pipe, fittings, etc., advice as to the grouping of employees, compensation of salesmen, profit sharing, cartage charges, freight deliveries, etc.

He bespoke a wider interest on the part of jobbers generally in the work of the association, adding that they should be willing to lend their financial aid and the value of their names on the association's membership roll, for the following reasons:

First—For the purpose of becoming better acquainted with your competitor, his character, his ideas, so that you may better judge as to the truth of the reports concerning him.

Second—As a means of obtaining information with reference to reports of salesmen, purchasing agents, etc., as to prices quoted.

Third—That we educate those responsible for unintelligent competition (which is many times responsible for the unprofitable business that we take) so that they will learn to compute their costs correctly, and thus provide a reasonable profit above the cost, and that we uphold by our united action those fundamental rules and trade customs, that by long trial and common consent, aid and support the fabric that we have built up by years of toil and sacrifice, and

Finally—That we secure the benefit of the experience of our competitors in a similar line and profit thereby.

Papers were read by A. E. Ford, of Philadelphia, on "Manufacturers' Competition and the Way to Meet It," and by Clarence V. Kellogg, of Chicago, on "Organized Effort of Distributors of Steam Supplies."

The following officers were elected for the ensuing year: President, J. P. Hartnett, L. M. Rumsey Manufacturing Co., St. Louis; first vice-president, A. L. Scott, Pacific Hardware & Steel Co., San Francisco, Cal.; second vice-president, C. V. Kellogg, Kellogg-Mackay Co., Chicago; treasurer, C. G. Cornell, Jr., Cornell & Underhill, New York; executive committee: F. M. Sheldon, Braman, Dow & Co., Boston; Geo. V. Denny, Savannah, Ga.; J. B. Rahn, U. S. Supply Co., Omaha, Neb.; W. M. Pattison, W. M. Pattison Supply Co., Cleveland, Ohio; S. H. Moon, Ahrens & Ott Manufacturing Co., Louisville, Ky.; W. T. Tobb, Pittsburgh, Pa.

The new advisory committee will be composed of past presidents and A. E. Ford, Philadelphia, and Charles H. Simmons, New York.

American Society of Mechanical Engineers

The date for the spring meeting of The American Society of Mechanical Engineers in Cleveland, O., has been changed to the last week in May, opening Tuesday, May 28 and closing Friday, May 31. The professional sessions will be held in the hall of the Chamber of Commerce. Among the papers on the programme are the following: "Strength of Steel Tubes, Pipes and Cylinders Under Internal Fluid Pressure," by Reid T. Stewart: "Control of Surges in Water Conduits," by W. F. Durand; "The Present State of Development of Large Steam Turbines," by A. G. Christie; "A

Discussion of Certain Thermal Properties of Steam," by G. A. Goodenough; "The Reduction in Temperature of Condensing Water Reservoirs Due to Cooling Effect of Air and Evaporation," by W. B. Ruggles; and "Results of Tests on the Discharge Capacity of Safety Valves," by E. F. Miller and A. B. Carhart.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

April Meeting of New York Chapter

An illustrated lecture on "Air Washers and Humidity," by J. I. Lyle, of the Carrier Air Conditioning Company of America, was the feature of the April meeting of the New York Chapter of the American Society of Heating and Ventilating Engineers. An attendance of 31 members was registered. Mr. Lyle showed numerous type of air washers and explained many features of their construction and operation, laying emphasis on the need of an efficient air scrubber and a free air passage. He also spoke of the importance of the atomized spray covering the entire space within the washer to secure the best results. Mr. Lyle stated that even with expert use the degree of error in the use of a sling psychrometer usually amounted to 3%.

Dr. William F. Colbert, of the Federal Furnace League, made a short address on ventilation and quoted extracts from an address made by Dr. W. A. Evans before the Midland Club, in Chicago. He urged closer coöperation between the heating engineers and the physicians in an effort to procure greater attention on the part of architects to the heating and ventilation requirements of buildings.

Illinois Chapter

A paper on "The Heating and Ventilating Plant of the Northwestern University at Evanston, Ill.," read by J. M. Stannard before the Illinois Chapter at its April meeting, aroused so much interest and discussion that the paper will be further elaborated for presentation at the summer meeting of the American Society of Heating and Ventilating Engineers. The plant includes both hot water and steam radiation and the discussion of the relative economy of one over the other brought out remarks from enthusiastic advocates of each type of heating. The committee, which was in charge of the meeting, composed of J. M. Stannard, chairman; E. F. Capron, C. F. Newport and R. A. Widdicombe, was heartily thanked for the success of its arrangements which included the distribution of prints showing the equipment of the buildings, and tables giving tests made of the apparatus.

The chapter expressed itself in favor of Detroit as the place for holding the mid-summer meeting of the parent society and President Lewis appointed Messrs. Small, Kirk and Ellis as a committee on transportation in case Detroit is decided upon.

Annual Meeting of the Federal Furnace League

The programme for the annual meeting of the Federal Furnace League, held in Detroit, Mich., May 6, provided for morning and afternoon sessions on that day. The morning session was devoted to routine business of the league. The afternoon session was open to all furnace manufacturers and all manufacturers of furnace supplies and fittings. The programme provided for the reading of papers by men outside of the furnace industry.

Following the discussion of these papers the most important matter before the convention was to be taken up, namely, the announcement by the secretary of the league, Dr. William F. Colbert, of the complete plan for the improvement of conditions in the furnace industry that the league has prepared. It was expected that the discussion and the possible adoption of a plan either on the lines laid down by the league or as modified by the convention, will mark the meeting as the most important of its kind that has been held in the furnace industry. For that reason efforts were made to secure as large representation as possible of manufacturers of furnaces and of furnace supplies and fittings.

The convention is in session as we go to press and the report of its deliberations will appear in the June issue.

Pennsylvania State Association

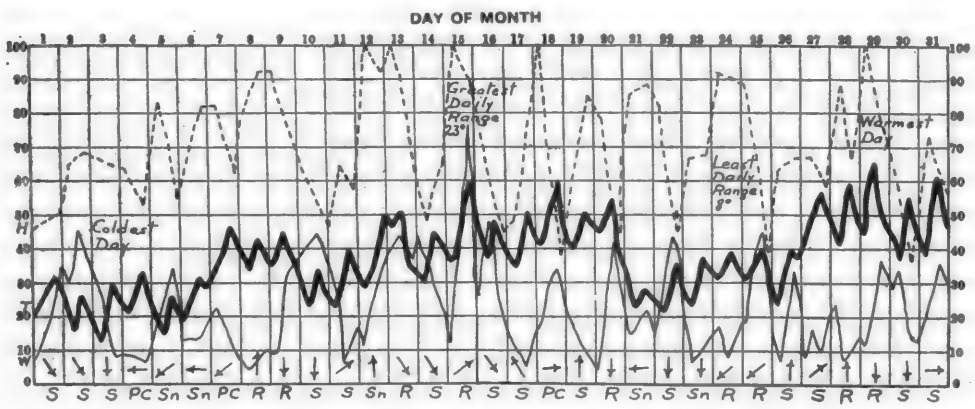
The 23rd annual convention of the Pennsylvania State Association of Master Steam and Hot Water Fitters will be held in Philadelphia, June 7-8, 1912. The time and place for the meeting are especially arranging to make it convenient for those attending to proceed to the annual convention of the National Association of Master Steam and Hot Water Fitters, in Atlantic City, June 10-13.

Standard Flange Schedule to be Extended

The New England Water Works Association has inaugurated a movement to extend the standardization of flanges for pipes up to and including 84 in. diameter. The association has invited the American Society of Mechanical Engineers and the National Association of Master Steam and Hot Water Fitters to coöperate in this movement through its former flange committees.

The Weather for March, 1912

	New York	Boston	Pittsburg	Chicago	St. Louis
Highest temperature, degrees F.	65	64	66	56	75
Date of highest temperature	29	31	19	31	31
Lowest temperature, degrees F.	13	11	12	6	15
Date of lowest temperature	3	4	10	1	6
Greatest daily range, degrees F.	23	34	31	25	32
Date of greatest daily range	15	20	19	19	30
Least daily range, degrees F.	8	6	7	3	5
Date of least daily range	24	21	13	28	12
Mean temp. for month, degrees F.	37	36	35	29	36
Normal mean temp. for month, deg. F.	37.5	35	39.5	28.8	43.5
Total rainfall, inches	5.68	4.18	4.83	2.20	5.85
Total snowfall, inches	4.2	9.1	3.5	13.5	28.8
Normal precipitation, this month, inches	4.10	4.08	3.01	2.55	3.43
Total wind movement, miles	13893	8511	8757	10079	7643
Average hourly wind velocity, miles	18.7	11.4	11.8	13.5	10.3
Prevailing direction of wind	N.	N. W.	N. W.	N. E.	N. E.
Number of clear days	8	14	6	7	12
Number of partly cloudy days	10	6	8	11	7
Number of cloudy days	13	11	17	13	12
Number of days on which rain fell	22	13	18	11	17
Number of days on which snow fell	5	7	7	7	12
Snow on ground at end of month, inches	None	None	None	Trace	None


DAY OF MONTH
Greatest Daily Range 23°
Least Daily Range 8°
Coldest Day
Warmest Day
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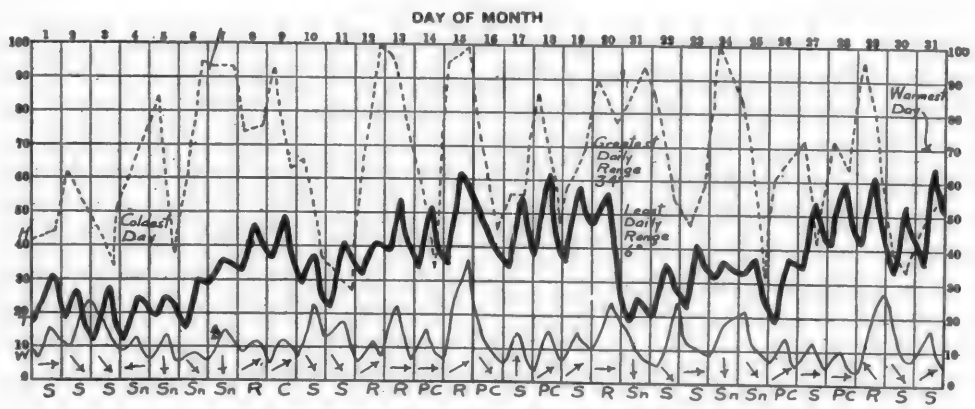
RECORD OF THE WEATHER IN NEW YORK FOR MARCH, 1912


DAY OF MONTH
Warmest Day
Greatest Daily Range 34°
Least Daily Range 6°
Coldest Day
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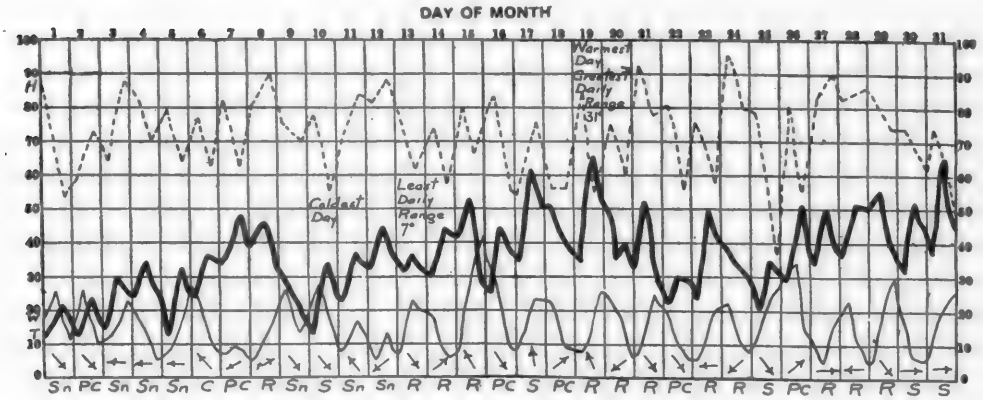
RECORD OF THE WEATHER IN BOSTON FOR MARCH, 1912


DAY OF MONTH
Warmest Day
Greatest Daily Range 31°
Coldest Day
Least Daily Range 7°
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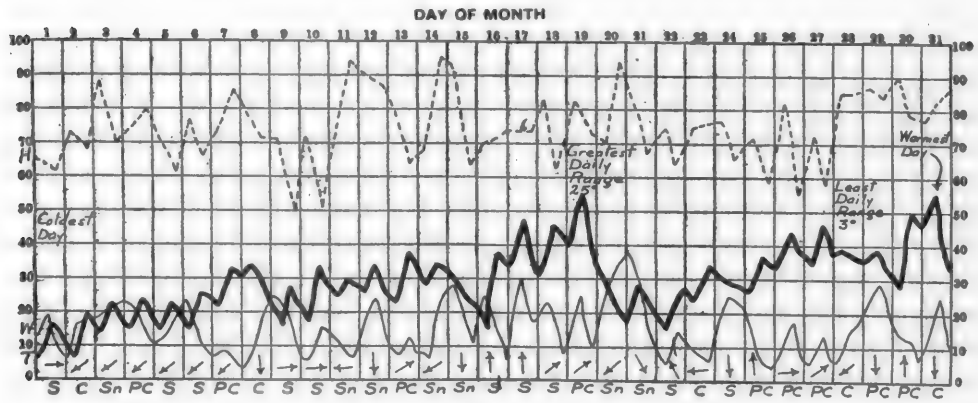
RECORD OF THE WEATHER IN PITTSBURG FOR MARCH, 1912


DAY OF MONTH
Coldest Day
Greatest Daily Range 25°
Least Daily Range 3°
Warmest Day
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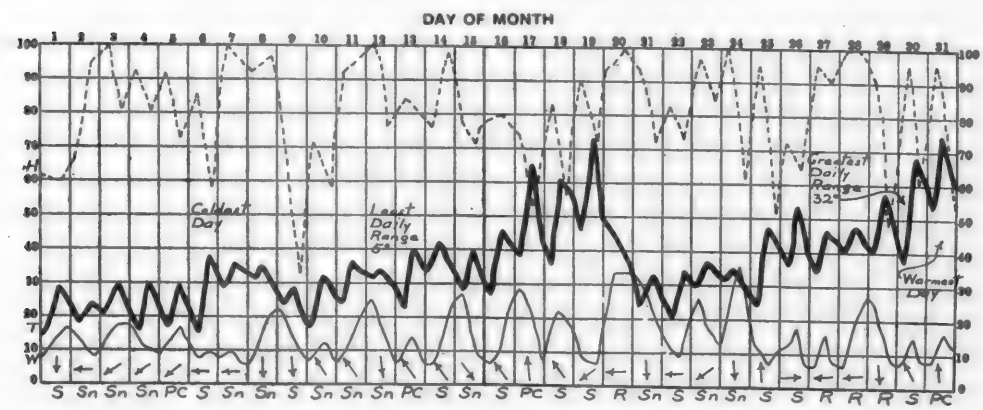
RECORD OF THE WEATHER IN CHICAGO FOR MARCH, 1912


DAY OF MONTH
Coldest Day
Least Daily Range 6°
Greatest Daily Range 32°
Warmest Day
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RECORD OF THE WEATHER IN ST. LOUIS FOR MARCH, 1912

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate humidity in percentage from readings taken at 8 A.M. and 8 P.M.
S—clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.
Arrows fly with prevailing direction of wind.

National District Heating Association

The detailed programme for the fourth annual convention of the National District Heating Association, to be held in Detroit, Mich., June 25-27, 1912, is as follows:

TUESDAY, JUNE 25, 10:00 A. M.

Addresses of welcome by the mayor of Detroit and by Alexander Dow, of the Edison Illuminating Co.

Response, George W. Wright, Baltimore, Md.

President's address.

Report of executive committee.

Report of Secretary-Treasurer.

TUESDAY, JUNE 25, 2:00 P. M.

Report of meter committee, A. P. Briggs, Detroit, Mich, chairman.

Paper: "Common Sources of Trouble in Customers' Installations," Wm. E. Darrow, Merchants' Light, Heat & Power Co., Indianapolis, Ind.

Paper: "Quality of Steam as Served by Central Stations to their Customers," A. C. Shepherd, Cleveland Electric Illuminating Co., Cleveland, Ohio.

WEDNESDAY, JUNE 26, 9:30 A. M.

Nomination and election of officers.

Report of committee on rates, R. D. DeWolf, Rochester Ry. & Light Co., Rochester, N. Y., chairman.

Paper: "An Analysis of Heating Rates," A. E. Duram, Central Station Engineering Co., Chicago, Ill.

Report of committee on central station records, H. R. Wetherell, Peoria Gas & Electric Co., Peoria, Ill.

WEDNESDAY, JUNE 26, 2:00 P. M.

Paper: "Heating in Connection with Curtis Steam Turbines," August H. Kreusi, General Electric Co., Schenectady, N. Y.

Paper: "Description of a Combined Steam Heating, Ice-Making, and Electric Power System," J. T. Lewis, Manager Murphy Heating Co., Detroit, Mich.

THURSDAY, JUNE 27, 9:30 A. M.

Paper: "Description of a Large Hot Water Heating System," G. E. Chapman, Chicago (Ill.) Public Service Company.

Paper: "Decentralized Steam Plants," S. M. Bushnell, Chicago, Ill.

THURSDAY, JUNE 27, 2:00 P. M.

Paper: "Depreciation in Underground Distribution Plants," W. Jennings, Harrisburg Steam Heat & Power Co., Harrisburg, Pa.

Paper: "Economic Survey of Combined Power and Heating Systems," E. D. Dreyfoos, Westinghouse Machine Co., Pittsburg, Pa.

Symposium: "Description of Underground Insulation," by a number of manufacturers of such insulation.

The entertainment for the convention is as follows:

For the ladies, Tuesday afternoon, automobile ride.

For all, Tuesday evening, theater party at Temple Theater.

For all, Wednesday afternoon, boat trip to the Flats, with afternoon session on the boat, and supper at the Flats.

For the ladies, Thursday morning, card party.

The association has charge of the exhibit hall and arrangements for space at the exhibit should be made directly with the secretary. The headquarters will be at the Hotel Cadillac, and reservations for rooms should be made directly with the hotel.

All inquiries regarding the convention and exhibit space should be directed to D. L. Gaskill, secretary, Greenville, Ohio.

An emblem of the association in gold and blue enamel has been selected by the committee appointed for that purpose at the Pittsburgh convention last year and may be obtained by members either in pin or button style at $1.00 apiece from the secretary, D. L. Gaskill, Greenville, Ohio.

Metric System in Denmark

Consul General E. D. Winslow, of Copenhagen, advises that the metric system of weights and measures went into effect in Denmark on April 1, 1912. It will be well for business men to note this change from the old system. All merchants will be subject to fines ranging from $2.70 to $27 for nonconforming with the act.

NEW DEVICES

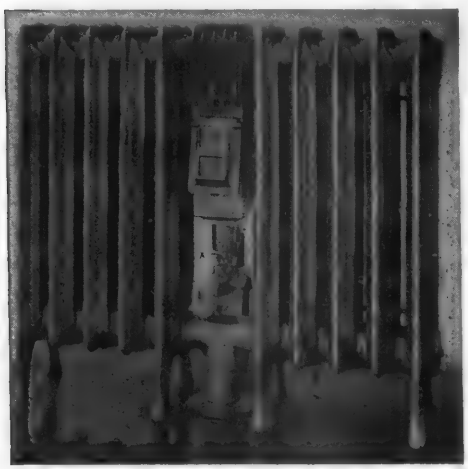
The Rector System of Heating

A unique type of gas radiator has lately been perfected by Alcorn Rector, of the Rector Lighting & Heating Co., New York, with branch companies in various cities, and will be marketed by a new company, to be known as the Rector Gas Heating Co., 131 West 31st St., New York. The novelty of the device lies in the manner of mixing the gas and air before combustion and in the maintenance of a partial vacuum in the box containing the burner. On these points the inventor states that while it is true that the gas and air must be perfectly mixed before perfect combustion can be secured, it is not necessary to have a surplus of oxygen surrounding the flame. In the Rector system the combustion takes place in a partial vacuum, maintained by means of an exhaust fan which may be located

at any point in the building and connected to the radiators bv means of small ducts. This partial vacuum, continuously maintained while the radiator is in operation, induces a rapid and continuous intake of air and gas. The point of air intake is indicated bv X in the accompanying illustration. This gas and air is in a rarefied state, due to the partial vacuum, which is stated to be an excellent condition for thoroughly mixing the two gases. By the process of rarefying, it is stated, the molecules of carbon in the gas are expanded and torn apart, and also the oxygen in the air.

At the burner, which is enclosed in a sealed box having a mica-faced door, the inventor has been able to procure a violet flame, which, he states, is made possible only by the rarefied condition within the combustion chamber where the flame is burning.

The combustion chamber is altogether unique. Being sealed against the atmosphere the only admission of air is that which enters with the gas. A remarkably high efficiency is obtained, due, the inventor states, to the fact that the comparatively cold outside air is excluded. All other burners, known to the engineering world, must have air surrounding



CAST-IRON RADIATOR EQUIPPED WITH RECTOR GAS HEATER

and mixing with the flame in order to prevent its extinguishment. Such cold air, coming in direct contact with the flame, affects its heat production to some extent.

The reasons, the inventor adds, that the Rector system burns gas in a sealed structure is due to the partial vacuum which immediately and continuously draws from the flame its products of combustion. These are in turn conducted through the sections of the radiator, and are carried thence to the exhaust pipe leading to the outside of the building. Each radiator may be equipped with a thermostat operating a pilot light and exhaust fan.

The system has been applied to a hot water heating system as shown in the

RECTOR GAS HOT WATER HEATER (AT RIGHT) USED IN PLACE OF HOT WATER BOILER TO HEAT RESIDENCE

accompanying photographic reproduction in which the hot water heater was installed to serve the purpose of the brick-encased boiler which was cut off.

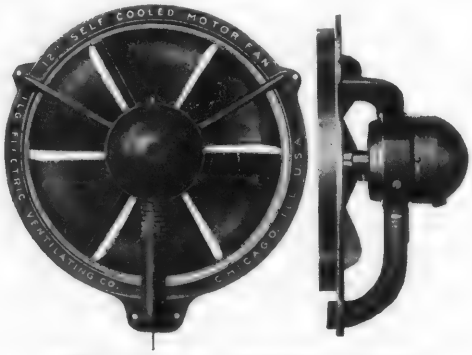
The system has been installed in a number of buildings with results showing, in sections where gas is a competitive fuel, savings in the gas heating bills of from 40% to 75%. The results obtained show that, with a typical room, say, 10 x 12 x 9 ft., a radiator containing 30 sq. ft. will consume 6 cu. ft. of gas per hour, while maintaining 70° F., with an outside temperature of 32° F.

The manufacturers of the Rector system have recently organized with the following officers: President, George H. Opdyke; treasurer, C. J. Curtin; secretary and heating engineer, Alcorn Rector; manager, H. B. Moll. A radiator equipped with the Rector system of heating has been set up for demonstration purposes at the company's quarters at 131 West 31st St., New ork, where it is attracting much interest.

New Types of Propeller Fans

Two n. r sizes of propeller fans, which are being put on the market by the Ilg Electric Ventilating Co., Chicago, Ill., are known as Ilg 12-in. and 16-in. propeller fans. They are described as entirely different from anything now on the market. They have curved blades and are equipped with fully-enclosed self-cooled motors. These fans are especially adapted for ventilating residences,

kitchens and all places requiring the movement of small quantities of air and can be operated from the electric light circuit. The 12-in. size has a consumption of 60 watts and an air delivery of 1,200 cu. ft. per minute. The 16-in. fan takes 90 watts and delivers 1,600 cu. ft. of air per minute. Both sizes are built for

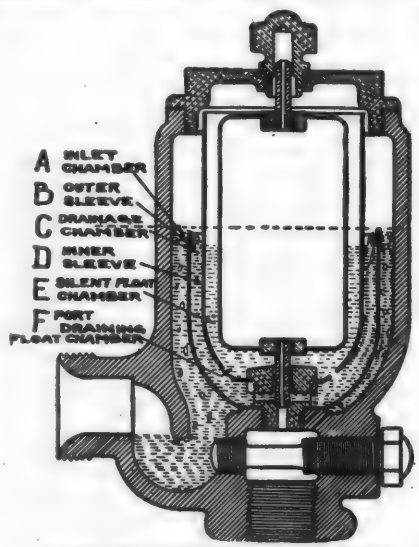


NEW TYPE OF ELECTRIC VENTILATING FAN

direct or alternating current at 110 and 220 volts. Speed regulators are not considered necessary, but, when desired, can be furnished for the 12-in. alternating and direct current fans and for the 16-in. fan, using direct current.

Monash Noiseless Radifier

The two principal disadvantages in the float type of valves for vacuum heating systems have been overcome in an interesting manner in the construction of the Monash noiseless radifier with its indi-



MONASH NOISELESS RADIFIER

vidual chambers for individual functions, as shown in the accompanying illustration. This valve is manufactured by the Monash-Younker Co., New York and Chicago, and is declared to be the last word in valve construction for vacuum heating systems. It is customary, in the construction of the float types of valve, to make the floating and drainage chambers one. In this chamber "for flotation and drainage" the float water is kept in constant agitation by its rapid and frequent filling and emptying, which may cause noise and chattering of the motor float. Other points that have to be provided for are the gathering of oil and grease which are not drained off into the return, but float on the surface and cake on the float, weighting the float and gradually raising the line of flotation, thereby affecting the efficiency of the valve.

In the Monash radifier, the float and drainage chambers are separate, each performing its individual function independently. In the drainage chamber, C, drainage into the return is direct, rapid and absolute. In the silent chamber, E, the body of water is always still, with a slight and gradual lowering of the line of flotation, thereby insuring silence in the action of the motor float. The separate drainage chamber, C, insures direct discharge of oil, grease, core-sand and dirt into the return pipe, not permitting it to enter into the silent float chamber, E.

The water of condensation, then, enters the inlet chamber, A, over the outer sleeve, B, into the drainage chamber, C, and through the ports, F, in the bottom of the inner sleeve, D, passing thence into the silent float chamber, E.

In operation, when the water in the silent float chamber, E, is at the line of flotation, the float rises and the valve opens, emptying the drainage chamber, C. With the outrush of water from the drainage chamber, C, the level of the water in the silent float chamber, E, is gradually lowered by the escape of a little water through the ports, F, when the float sinks, closing the valve. Provision is made for the continuous removal of air through the float.

H. W. Johns-Manville Company Move to Larger Quarters

The executive offices and New York show rooms of the H. W. Johns-Manville Co., manufacturers of asbestos, magnesia and electrical supplies, were moved on April 20 to the new twelve-story "H. W. Johns-Manville Building," Madison avenue and 41st Street, New York, from their old quarters at 100 William St., where they have been located for the past 15 years.

This move marks the 54th anniversary of the company. Under the name of H. W. Johns Manufacturing Co., the business was conducted at 87 Maiden Lane, previous to May 1, 1897, when it was moved to 100 William Street. In 1901 the firm name was changed to H. W. Johns-

Manville Company, a consolidation being effected between the Manville Covering Co., of Milwaukee, Wis., and H. W. Johns Mfg. Co. This last combination brought together two of the largest manufacturers of pipe and boiler coverings, packings, roofings, etc., in the world.

Child & Scott Co., New York, Succeeds G. A. Suter & Co.

Earnest T. Child, George M. Scott and John E. Leffrey announce that they have formed the corporation of Child & Scott Co., which has succeeded to the business of G. A. Suter & Co., New York, as engineers and contractors for heating and ventilating apparatus. The members of the new firm were officers in G. A. Suter & Co. The announcement is accompanied by a statement by George A. Suter bespeaking a continuance of the patronage long accorded this firm.

Ideal Heating Journal for April, published by the American Radiator Co., Chicago, contains, among many interesting articles, one on "Efficiency of Radiator Surfaces Affected by Paints," in which a comparison is made between enamel and bronze for radiator surfaces. The enameled surfaces were found to have a decided advantage over bronzed surfaces, ranging from 9 to 15%. Illustrated descriptions are included, showing the method of testing the radiating power of substances.

Graphite for April, 1912, the periodical of the Joseph Dixon Crucible Co., Jersey City, N. J., contains the first installment of an article by Elbert Hubbard on "Joseph Dixon, One of the World Makers."

Buffalo Spiro Turbine, the remarkable design of steam turbine, recently placed on the market by the Buffalo Forge Co., Buffalo, N. Y., is the subject of a 4-page circular, 8 x 11 in., in which the features of this machine are described and illustrated in detail. The company announces that the Spiro turbine is at present made in sizes up to and including 60 H. P. Special attention is called to the simplicity of the design, consisting practically of five parts: the case, two runners (of the herringbone type), and the heads with bearings. Specifications are included for the seven sizes now manufactured, in which the horse power is based on 100 lbs. initial pressure, 2,000 R. P. M., non-condensing.

Hydro line of recording instruments, manufactured by Herman Bacharach, Pittsburgh, Pa., including Hydro recording and indicating meters for measuring pressure, draft, velocity and volume of air; and Hydro differential draft recorder and indicator for use in boiler plants ar: featured in new circular matter in which the devices are illustrated and their uses described at length.

Indicating Gauges for All Purposes is the title of Bulletin 60, dated March, 1912, published by the Industrial Instrument Co., Foxboro, Mass. The line as shown in the bulletin covers indicating gauges for all pressures and purposes. The instruments especially featured are two models of pressure and vacuum gauges equipped with the company's special "independent movement," in which the movement is independent of the case from which it is separated by a liberal air space, so that it cannot be strained or distorted by twisting the case or affected by unequal thermal expansion. The catalogue contains illustrations of the complete line, together with price lists. Size 8 x 11 in., punched for binding. Pp. 16.

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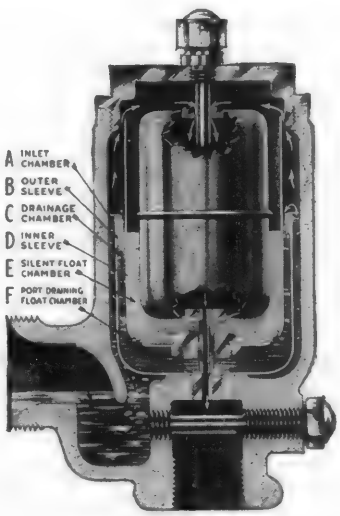
NOISELESS

VALVES FOR VACUUM HEATING SYSTEMS

THE SILENT FLOAT CHAMBER IN THE MONASH RADIFIER

MAKES ITS OPERATION ABSOLUTELY NOISELESS



In the MONASH NOISELESS RADIFIER the float and drainage chamber are separate, each to perform its individual function. In the drainage chamber (C) drainage into the return is direct, rapid and absolute. In the silent chamber (E) the body of water is always still with a slight and gradual lowering of the line of flotation—thereby insuring silence in action of the motor float.

ATTENTION—To Heating Engineers who are interested in specifying Vacuum Heating Systems and who will write us on their letterhead, we will send our BOOK OF BLUE PRINTS showing typical installations for MONASH NOISELESS SYSTEM of Vacuum Heating. The information contained in this book has never before been published. Write at once as the edition is limited.

MONASH-YOUNKER CO.

121 W. 42d Street, New York **1420 W. Jackson Boulevard, Chicago**

TRADE AND MISCELLANEOUS NOTES

Coming Events

Second Tuesday in Each Month—Meeting of the New York Chapter, American Society of Heating and Ventilating Engineers.

June 3-5, 1912—Second National Conference on Industrial Diseases, Atlantic City, N. J. Headquarters at the Hotel Marlborough.

June 10-13, 1912, inclusive, twenty-fourth annual convention of the National Association of Master Steam and Hot Water Fitters, Atlantic City, N. J. Headquarters at the St. Charles Hotel.

June 25-27, 1912—Fourth annual convention of the National District Heating Association, Detroit, Mich. Headquarters at the Hotel Cadillac.

Sept. 24-26, 1912—Fourteenth annual conference of the American Hospital Association, Detroit, Mich.

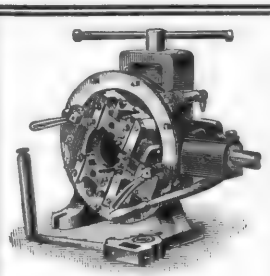
Deaths

Frank Kenrick, of the heating and plumbing firm of Kenrick Bros., Brookline, Mass., a brother of Alfred E. Kenrick, died at his home in Brookline, April 9. He was 55 years old.

John H. Mills, vice-president of Abendroth Bros., Portchester, N. Y., died of pneumonia April 9, at his home in Portchester. He was 43 years old.

Andrew Young, one of the first presidents of the National Association of Master Plumbers and for many years a prominent figure in the heating and plumbing trade in Chicago, died in Mobile, Ala., March 25. He was 72 years old. Mr. Young was chief sanitary inspector of Chicago from 1889 to 1903, when failing health caused him to retire.

Charles V. Sales, formerly president of the United States Supply Co., St.



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CUTS OFF AND THREADS PIPE

From 1 Inch to 4 Inches

TO BE USED FOR EITHER HAND OR POWER

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THE ARMSTRONG MFG. CO.

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THE McCREERY AIR SCRUBBER

Spray alone will not wash out **soot** and other **oily particles** from the air. These are what produce the **"smoke nuisance."**

Our Air Washers have therefore always been built with wet **cleaning surfaces** to catch the dirt and assist in humidifying and cooling the air.

The **flushing spray heads,** brought our by our Company, are now recognized as necessary to the uninterrupted operation of Air Washers and are specified by the leading Engineers.

The **Experimental Plant** originally installed by us in 1907, has been remodeled from time to time in order to obtain valuable knowledge of air conditioning.

We specialize in **Industrial Work,** as the high efficiency of our cleaning and humidifying device enables us to overcome difficult conditions.

CORRESPONDENCE SOLICITED

McCREERY ENGINEERING COMPANY, DETROIT, MICH.

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Paul, Minn., dealers in heating and plumbing supplies, died in St. Paul, March 20. He was 55 years old.

W. Tracy Clow, manager of the export department of Jas. B. Clow & Sons, Chicago, was accidently killed March 16, by falling down an elevator shaft in the Masonic Temple, Chicago. He was 39 years old. Mr. Clow was a cousin of William E. Clow, president of Jas. B. Clow & Sons.

John Dickey Culbertson, second vice-president and treasurer of the National Tube Co., Pittsburg, Pa., died suddenly March 13.

As a result of Mr. Culbertson's death, the following changes are announced in the company's organization: Second vice-president, Taylor Alderdice, formerly third vice-president; office of third vice-president discontinued; secretary, B. C. Moise, formerly auditor, assistant secretary and assistant treasurer; treasurer, G. E. Benson, formerly credit manager; assistant treasurer, J. W. McKee; assistant secretary, C. B. Foster.

I. Chester G. Wilkins, engineer in charge of electrical and heating work, Thompson-Starrett Co., New York, died April 20, following an attack of nervous prostration.

Miscellaneous Notes

Iowa Falls, Ia.—Local coal dealers state that owing to the severity of the past winter, about 50% more coal was consumed in Iowa Falls than during the previous winter. These figures were duplicated in many parts of the country.

Kalamazoo, Mich.—At a special election held April 11, the heating franchise asked for by the Central Station Engineering Co., of Chicago, was voted down, the plurality against the measure being 949. The vote was exceedingly light. This proposed franchise has been before the city council for several months.

Kansas City, Mo.—Warrants charging failure to comply with the fire protection and ventilation ordinances for public safety have been served on all of the proprietors of theatres in Kansas City. The action was taken as the result of an inspection made by W. L. O'Brien, deputy state factory inspector.

St. Louis, Mo.—The Board of Health has approved bills providing for an even temperature and proper ventilation of street cars of St. Louis. The bill will soon be introduced in the Municipal Assembly.

South Bend, Ind.—A 50-year franchise has been asked for by the St. Joseph Heating Co., recently organized in South Bend, to lay pipes and mains through the principal streets and furnish heat to the residences and business buildings of the city. According to the petition presented to the Board of Public Works, the company agrees to furnish heat to the people of the city from September 15 to June 1, whenever the temperature falls as low as 60° F. above zero. A special rate is to be charged as long as Hocking Valley run of mine can be secured f. o. b. at $2.50 a ton or Indiana mine run at $2 a ton, f. o. b. South Bend. For every increase of 25 cents a ton on the coal the company is to have a right to increase its rates 5% and if a decrease of 25 cents

ALL YOU NEED

to transform your present system to an efficient and economical one, are the

SIMONDS VACUUM VALVES

and a small pump. Place the valves on the outlet end of your radiators and coils—start up your pump—your heating wastes are at once **Remedied**

Write TO-DAY for our new 1912 Catalog—Dept. 5.

SIMONDS HEATING & SPECIALTY CO., Grand Rapids, Mich.

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That's what Dixon's Pipe Joint Compound does and yet permits easy disconnection whenever this is desired.

JOSEPH DIXON CRUCIBLE COMPANY Jersey City, N. J.

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a ton for coal is secured a 5% decrease in rates is to follow.

Under the agreement the company is to charge 75 cents per 1,000 for the first 50 lbs. of steam for a square foot of radiator surface. All additional heat is to be charged at the rate of 45 cents a thousand. The charges are to be made on the water from which steam is condensed after steam has been used.

The company has also a flat rate, which is to be not more than 35 cents per square foot of radiator surface for the season. Where no heat is used the company has a right to collect 2½ cents per square foot of radiator surface for the seven winter months and 1¼ cents for September and May. The payments are to be made monthly.

St. Joseph, Mich.—Owing to notice of an increased charge for heating the Berrien County court house and jail, which was made by the Benton Harbor & St. Joseph Railway & Light Co., which is now heating these buildings from its power house, the building committee of the board of public works has decided to operate its own steam plant located in the jail building. The plant will, therefore, be repaired and put in commission. The railway company stated that the increased charge would have been necessary as it was about to do away with the power house that furnished heat to these buildings.

Chris. Irving Plumbing & Heating Co., Denver, Colo., suffered a loss of $14,000 through the embezzlement of its bookkeeper, covering a period of two years.

Chicago, Ill.—Henry Ericcson, commissioner of buildings, has made a re-

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THE HEATING AND VENTILATING MAGAZINE

FOR 1912 TO

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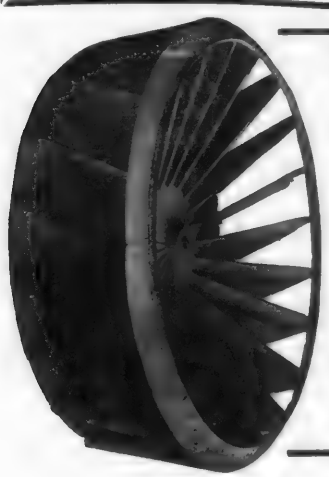
Payment ($1.00) enclosed herewith

Jenkins Bros. Radiator Valves

The installation of these valves secures for your clients the heaviest radiator valves made. Highest grade metal and workmanship. Full opening. All parts renewable. Can be packed under pressure.

Jenkins Bros.

New York Boston Philadelphia Chicago



Not a Bird Cage, a Squirrel Cage, a Rat Trap or a Skyrocket—but—

A Cycloidal Fan or Blower

for all purposes. The only radical improvement in fans in forty years. Takes up less room, runs at slower speed, requires less power, noiseless in operation.

We guarantee our Cycloidals to equal in capacity any fan built—**We bar none**—with from 20 to 25 per cent. less speed and power. We build them in all sizes to suit all conditions—hundreds of them in use—not "as good—but better."

GARDEN CITY FAN CO.

Patentees and Sole Manufacturers

1532 McCORMICK BUILDING CHICAGO

Established 1879

Eastern Sales Agent, L. J. Wing Mfg. Co., 90 West St., New York

Send for Catalogs 110 and 120, just issued

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port to the commissioner of public works on the findings made by three of his assistants who have been making an examination of the equipment of the City Hall. The marble work and the heating and ventilating systems of the structure are criticised.

Pawnee City, Neb.—A movement is on foot to install a central station heating plant in Pawnee. City Electrician Johnson, of Falls City, who has had charge of central heating installations at Sabetha, Kan., and at other points was a recent visitor to Pawnee in connection with the proposed project.

Milwaukee, Wis.—The county board has engaged Eugene McAlear, of Chicago, to estimate the cost of establishing a central light, heat and power plant for the county buildings at Wauwatosa.

Iowa Falls, Ia.—The school board of the Iowa City public schools has decided to enlarge the present heating system of the high school building to such an extent that it will be able to heat all the buildings on the block. The proposition to build a new central heating plant was dropped.

Belvidere, Ill.—The Belvidere Public Service Operating Company, comprising the gas works, electric light plant and a plant furnishing heat throughout the city by the Yaryan system, it is stated, is likely to change hands shortly. It is said that an option has been taken on the property at a figure approximating $300,000.

New York Fold of the United Bunch of Sheep is arranging to hold an open social meeting during the week of May 20, to which salesmen in the heating and plumbing trades, who are non-members will be welcomed. The committee in charge is composed of Thomas H. Hutchinson, Henry Stein, P. Schwab, W. S. Schulmerich and Frank Silkman.

Thomas S. Ainge, formerly sanitary engineer for the Michigan Department of Health, has opened an office in Lansing, Mich., as consulting sanitary engineer.

Illinois Civil Service Commission, announces that an examination will be held in Chicago, May 7, 1912, to fill present and future vacancies in the Department of Factory Inspection. The examinations are open to men and women between the ages of 20 and 50. Those taking the examination for the ventilation branch of the Inspection Service, must have both technical and practical training in ventilation and sanitation, must understand the occupational disease law, and be able to locate and analyze industrial poisons. The positions in this branch pay $100 per month, with the

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Mr. Contractor:

Get after them on the double quick. You hustle for the job and *we'll help.* If you'll figure on a

THE MOLINE (M) SYSTEM HEATING

we will completely design and work out in every detail plans and specifications *free.* Make a good profit, Mr. Contractor! Hitch up with us.

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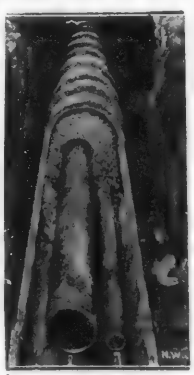
A Valuable Book Free.—Send for our Contractor's Catalog—besides telling all about the Moline System it gives a great amount of valuable information on the proper installation of heating systems, which may prove profitable to you.

Moline Vacuum-Vapor Heating Company
Dept. E MOLINE, ILLINOIS

J-M Sectional Conduit



This is a tile conduit, salt-glazed inside and out. Is absolutely watertight.

Acids, gases or the action of the earth do not affect it. Neither can it be injured by weight or movement of pipes. Practically indestructible.

Easily opened after installation. Can even be taken up and relaid. The most efficient conduit for conveying steam, gas, water, brine or other liquids underground.

Saves 90% of heat lost in transmission through unprotected or poorly insulated pipes.

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Chicago	Milwaukee	San Francisco
Cleveland	Minneapolis	Seattle
Dallas	New Orleans	St. Louis
Detroit	New York	

(1384)

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necessary traveling expenses. Applications must be on file at the office of the commission in Springfield, Ill., prior to 9 A. M., May 10. Requests for application blanks should be made to W. R. Robinson, chief examiner, Civil Service Commission, Springfield, Ill.

Rudolph Diesel, director of the Verein Deutscher Ingenieure, and the inventor of the Diesel engine, has been elected an honorary member of The American Society of Mechanical Engineers. The honorary membership was conferred upon him at a meeting of the gas power section of the society, April 30, 1912, when Dr. Diesel gave an illustrated address on "The Development of the Diesel Engine."

Manufacturers' Notes

United States Radiator Corporation, Detroit, Mich., has taken permanent possession of the plant and property in Paola, Kan., where it has been operating a branch plant. A new building, 60x145 ft. will be put up and new machinery added for the manufacture of radiators. A switch will run to the property from the Missouri Railway. The final arrangements with the city council were conducted by C. G. Blackmore, vice-president of the corporation.

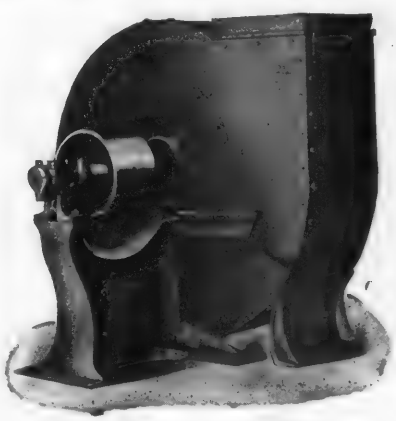
L. J. Mueller Furnace Co., Milwaukee, Wis., is placing on the market a new vacuum cleaning apparatus, designed for use in residences. The cleaner is operated by an electric motor.

Simonds Heating & Specialty Co., Grand Rapids, Mich., manufacturer of the Simonds system of vacuum steam heating, has opened a Minnesota branch office in St. Paul. The Simonds valves will be installed in the J. B. Whitacre Company factory, in that city.

Central Foundry Co., New York, through its president, Waddill Catchings, reports gross business for the eight months ended December 31, 1911, at $1,867,920, and net profits at $124,888.

Joseph Dixon Crucible Co., Jersey City, N. J., at its annual meeting, April 15, re-elected the retiring board of directors consisting of George T. Smith, William Murray, Edward L. Young, William H. Corbin, George E. Long, William G. Bumsted and Harry Dailey. Officers elected for the ensuing year are as follows: President, George T. Smith; vice-president, W. H. Corbin; treasurer, George E. Long; secretary, Harry Dailey; assistant secretary, J. H. Schermerhorn.

Hart & Crouse Co., Utica, N. Y., manufacturer of the Royal line of steam



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In numerous tests they have been proven the equal and in some cases superior to any roller or ball-bearing for fan practice.

The friction does not increase with use, for they operate with undiminished efficiency for years.

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The fan to meet your requirements is waiting to be shipped from stock.

Our engineering organization is ready to make suggestions if you will write them fully about your requirements.

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B. F. STURTEVANT COMPANY

HYDE PARK, MASS. 860

Please mention THE HEATING AND VENTILATING MAGAZINE *when you write.*

and hot water boilers, has added a jobbing department for heating, plumbing and tinning supplies. The company has moved into its new building on Turner Street and the jobbing department will occupy the old quarters on Lafayette Street. This department will be under the management of L. H. Birdseye, for many years with the Charles Millar & Son Co.

United States Radiator Corporation, Detroit, Mich., announces that it has taken over the United Vacuum Appliance Co., of Connersville, Ind., and the Electric Renovator Mfg. Co., of Pittsburg, and is now prepared to market a complete line of vacuum cleaners for every purpose. In taking over these two concerns, the corporation states that it also secures the services of their entire manufacturing and engineering departments.

National Tube Co., Pittsburg, announces an increase in its capital stock from $9,000,000 to $13,000,000. The additional $4,000,000 of stock is to be purchased at par by the Federal Steel Company, which already owns all the outstanding stock of the National Tube Co. Judge Elbert H. Gary, chairman of the United States Corporation, which controls both companies, states that the proceeds of the $10,000,000 in bonds recently sold by the National Tube Company, and of the issue of additional stock will be used in liquidating loans due by the National Tube Company to the United States Steel Corporation and other subsidiary companies of that corporation for moneys borrowed to pay for actual outlays for additions and extensions and for working capital. The National Tube Company will therefore, have no floating debt. Its current assets, it is stated, are largely in excess of all current liabilities.

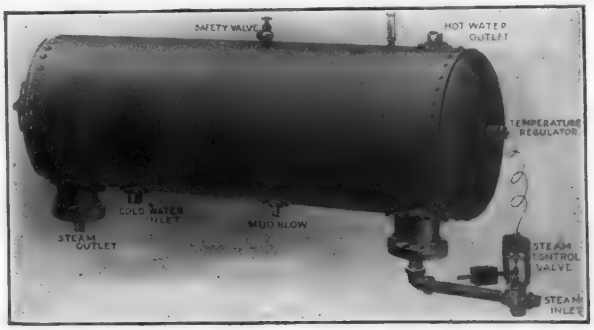
Standard System of automatic temperature control, manufactured by the Standard Regulator Co., 90 West St., New York, was installed in connection with the heating and ventilating plant for the Christian Union Congregational Church, Upper Montclair, N. J., which was described in the April issue.

Illinois Blower & Sheet Metal Co., Chicago, Ill., is the changed name of the Illinois Blower Co. The company has increased its capital stock from $5,000 to $10,000.

Shirley Radiator & Foundry Co., Indianapolis, Ind., has started building its new plant at Beech Grove, a suburb of Indianapolis. When completed it is stated the plant will be one of the largest independent boiler and radiator plants in

HOT WATER FOR ANY PURPOSE

Used with Live or Exhaust Steam. With any Low Pressure Heating System.



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PATTERSON HOT WATER HEATERS

are not confined to one style, but are built in various types and styles to meet any and all conditions.

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the country. The work is going forward under the immediate supervision of F. W. Smith, vice-president and general manager.

Allis-Chalmers Co., Milwaukee, Wis., it is announced, will be reorganized with a capital stock of $42,500,000, to consist of $26,000,000 common and $16,500,000 7% cumulative preferred.

New Firms and Business Changes

Hygienic Ventilator Co., Chicago, has increased its capital stock from $3,000 to $25,000.

W. H. Johnson & Son Co., Indianapolis, Ind., heating contractors has moved into its new two-story office and factory building on East St. Joseph Street, in that city.

Michaelson Heating Co., Denver, Colo., will build a new warehouse at West Colfax Ave. and Elati Street, to cost about $6,000. The building will occupy a site 25x125 ft. and will be two stories high.

Loew Mfg. Co., Cleveland, O., manufacturers of pipe threading machinery, feed water heaters and other steam specialties, has increased its capital stock from $75,000 to $400,000.

Dewstoe & Brainard Co., Cleveland, O., one of the oldest heating and plumbing firms in the middle West, has been dissolved, following the death, some months ago, of the president of the firm, C. C. Dewstoe. Charles H. Warner, who was with the company for many years, has established a heating and plumbing business under the name of C. H. Warner & Co., at 721 Saint Clair Avenue, N. E., Cleveland.

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New Corporations

Daylight Burner Co., Cincinnati, O., capital $5,000, to manufacture burners for lighting and heating. Incorporators: Emil H. Kuhr, Iva E. Kuhr, Walter Bihrer, Otta Croutz and George H. Bohrer.

St. Joseph Heating Co., South Bend, Ill., capital $100,000, to operate a central station hot water heating plant in South Bend. The incorporation is composed of men prominent in the Indiana & Michigan Electric Co. A franchise has been asked of the board of public works. It is proposed to utilize exhaust steam from the plant of the electric company to heat water. Incorporators: Charles A. Chapin, Chicago, president of the electric company; and his son Lowell Chapin, South Bend, who is general manager of the electric company.

Ohio Boiler & Heating Co., Columbus, O., capital $3,000. Incorporators: C. M. Buller and others.

Emmert Hardware & Cornice Co., East St. Louis, Mo., capital $15,000, to engage in general hardware, furnace, plumbing and heating business. Incorporators: William T. Emmert, Annie M. Emmert and Henry Warning.

Erie Ventilator Co., Erie, Pa., capital $25,000. Incorporators: Frank R. Leet, W. W. Walker and Grant J. Smith, all of Erie.

Western Heating Co., St. Louis, Mo., capital $4,000, to manufacture and install heating apparatus. Incorporators: Harry W. Rigg, W. J. S. Hemphill, Alice E. Rigg and Mary W. Hemphill.

Arcade Lighting & Heating Co., Dayton, O., capital $5,000, to furnish heat, light and power. Incorporators: John A. McMahon, Stella O'Neall, Samuel W. Froehle, Robert K. Landis and Robert G. Corwin.

Sanitary Kitchen Ventilating Co., Boston, capital $50,000. Incorporators: Christian J. Ubhoff, Charles O. Quimby and A. P. Phillips,

Whitmore Electric Heating Co., Salt Lake City, Utah, capital stock $50,000. President, A. O. Whitmore; vice-president, Jenetta R. Whitmore; secretary, Ernest M. Fowler; treasurer, William Charles Stainer.

Roath Heating and Ventilating Co., Akron, O., capital $10,000, to conduct heating, ventilating and plumbing business. Incorporators: Sherman M. Roath, Edna G. Roath, William S. Roath, Clarence A. Whisler and Agatha McGinnis.

P. W. Schneider, Inc., Utica, N. Y., capital $10,000, to conduct a heating and plumbing business. Incorporators: Paul W. Schneider, Anna S. Schneider, Geo. J. Alcicker, all of Utica.

Beekman & Franz, Springfield, Ill., capital $10,000, to conduct a heating and plumbing business. Incorporators: H. T. Beekman, Fred Franz, Jr., and L. G. Eberly.

Dermott Heating Co., Durham, N. C., capital $25,000, to conduct a heating business. Incorporators: J. V. Dermott, George McCrackin and E. J. Schantz.

Wise-Harrold Electric Co., New Philadelphia, O., capital $30,000, to manufacture vacuum cleaning apparatus.

Greenfield Tap & Die Co., Greenfield, Mass., with a capital stock of $1,000,000 preferred and $1,000,000 common, was organized in Boston, April 2, to act as a holding company for the Wiley & Russell Mfg. Co., and the Wells Bros. Co., both of Greenfield. The merger was arranged by Turner, Tucker & Co., of Boston, who first secured an option for two-thirds of the capital stock of the Wiley & Russell Mfg. Co., the option price being $600,000, or about $1,800 a share. The business was established by Charles P. Russell, president and treasurer of the concern, who now retires. The officers of the new company are: President, F. O. Wells, Greenfield; vice-president, W. M. Pratt, Greenfield; treasurer, F. H. Payne, Boston; directors, above-named officers and J. W. Stevens, Greenfield; A. C. Dutton, Greenfield; J. H. Drury, Athol; and W. J. Carlin, Boston.

Central Plumbing & Heating Co., Saline, Kan., incorporated to take over the business of the McConnell & Woods Plumbing Co. The interest of Mr. Woods in the old firm was purchased by C. A. Test, who, with Mr. McConnell, will manage the new concern.

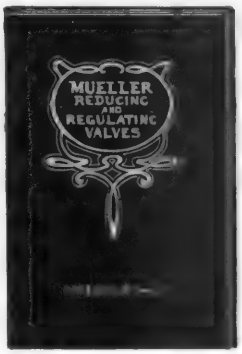
Contracts Awarded

P. L. McQuillan, Chippewa Falls, Wis., heating and plumbing for Women's Dormitory at Madison, Wis., for $15,000.

St. Paul, Minn.—Bids for the heating and ventilating of the new pathological laboratory and garage to be added to the City and County Hospital were as follows: M. J. O'Neill, $3,178; Healy Plumbing & Heating Co., $2,632; McQuillan Bros., $2,800; Hanks & Eha, $2,396.

Anderson, Ind.—A contract to rebuild the steam heating plant of the Central Steam Heating Co., of Anderson, has been let to the American District Heating Co., North Tonawanda, N. Y. The trunk line will be a 14-in. main, surrounding a territory six blocks wide and ten blocks long, including all of the business section, five school buildings and the central portion of the residence section of the city. The work will begin early this month.

Hanley-Casey Co., Chicago, heating plant for the Peoria State hospital,



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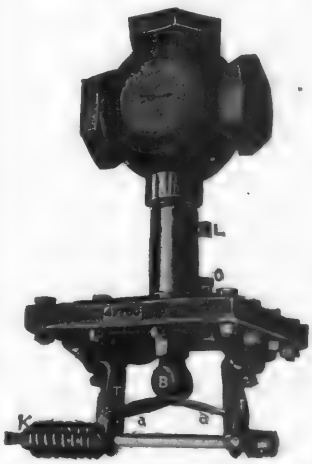

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A very sensitive and reliable regulator for purposes designed. It is a high grade low pressure regulator. Superior to other makes in construction and workmanship. Has no weights or close fitting pistons and is easily adjusted to pressure desired between zero and 15 pounds.

Made in sizes ¾-inch to 12 inch. Smaller sizes 2-inch and under, are fitted with brass bodies; larger sizes have iron bodies, composition mounted and composition *renewable seats*.

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Foster Engineering Co., Newark, N. J.

awarded by the State Board of Administration. The contract amounts to $44,450. Other bids were: Charles W. O'Neill, Peoria, $51,554; John O'Neill & Son, Peoria, $62,870.

Frank A. Sullivan, Santa Rosa, Cal., heating and ventilating new $10,000 Carnegie library at Oroville, Cal.

Doerr & Lechsinger, Watertown, Wis., heating and plumbing for Watertown gymnasium.

R. R. Moore, Wichita, Kan., heating new high school building at Sedgwick, Kan., for $2,250.

J. D. Wilson, Mason City, Ill., heating and plumbing new county farm building at Mason City, for $3,085.

Hanley-Casey Co., Chicago, heating asylum buildings at Bartonville, Ill., for $45,200.

Somerville, Mass.—Bids for the heating and ventilating of the new school building in Somerville were as follows: Braman, Dow & Co., $12,155; W. W. Campbell & Son, $11,908; Hern-Furlong Co., $11,370; J. F. Foster, $10,586; Huey Bros., $10,277; J. J. Hurley, $10,456; Lynch & Woodward, $12,144; McLean & Cousens, $11,241; J. F. Morgan & Son, $12,296; Pierce & Cox, $10,886; W. B. Ross, $12,145; Charles H. Sanborn, 10,-$300; P. J. Sullivan, $10,200; Arthur J. Sanford, $11,900; Whitten & Jackson, $12,177; Frank E. Woodward & Co., $12,-610; F. W. Zemier & Co., $11,076; Commonwealth Heating Co., $10,234. Action on the bids was deferred.

John Perra, New Bedford, Mass., heating, ventilating and plumbing new Katherine Street School for $12,766; the plumbing and vacuum cleaning contract went to Jeremiah Colohan at his bid of $7,050. Other bids for the heating, ventilating and plumbing work were: Wood, Brightman & Co., $16,442; James N. Conway, $12,997; Charles H. Sanborn, $13,-515; Isaac Coffin & Co., $14,966; W. W. Campbell & Son, $13,998.

Thomas E. Gildea, Syracuse, N. Y., heating and ventilating plant for State Capitol at Albany, N. Y. The contract amounts to $42,000.

Chas. J. Gustafson, St. Paul, Minn., heating, plumbing and gas fitting for new Turkish bath house on Jackson Street, St. Paul, for $2,657.

Charles E. Thomas Co., San Francisco, Cal., heating and ventilating San Francisco Girls' High School for $29,850.

Turner Co., San Francisco, Cal., heating and electrical work for the Sheedy Estate apartment building on Larkin Street for $3,600.

Robbins & Gamwell Co., Pittsfield, Mass., heating and ventilating addition to the Briggs School, Pittsfield, for $9,-725.

Fall River, Mass.—Bids were received for the heating and ventilating of the new school building to be built at Whipple and Hamlet Streets, Fall River, as follows: T. D. Kelly, $8,000; American Plumbing & Heating Co., $6,662; Fall River Steam & Gas Pipe Co., $6,675; Peter Leary, $7,285; Lagasse Bros., $6,-450; Nathan Miller & Sons, Ltd., $7,498; John F. Johnston, $6,914. The contract was not let.

Business Chances

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following-named work:

Until May 21, 1912, for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring, etc., for the United States Post Office at Alameda, Calif.

Until May 27, 1912, for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits, etc., for the United States Post Office at Westfield, Mass.

Springfield, Mo.—Plans for an outside heating plant for the Springfield High School will be asked at an early meeting of the Springfield Board of Education. An expenditure of $10,000 is contemplated.

Buffalo, N. Y.—The board of supervisors has passed a resolution providing that a heating engineer be employed to prepare plans and specifications for a new heating plant at the penitentiary. The plant will cost about $10,000. The design will be made by the Richard D. Kimball Co., of Boston.

Rock Island, Ill.—Lewis & Kitchen, Chicago, have been directed by the board of education of Rock Island to draw up plans and specifications for the central heating plant to be installed in the new manual arts building in that city.

Iowa Falls, Ia.—The State board of education is planning to build a new heating plant and laundry for the use of the university hospital, to cost $30,-000. Work will be started in the Fall in time to have the plant ready by winter. W. R. Boyd, of the finance committee of the State board, has the work in charge.

Oakland, Calif.—Plans for new school buildings to be built shortly contemplate a total expenditure of $2,493,900. The city has recently voted favorably on a bond issue to cover this cost.

Wanted

Heating and Ventilating Engineer.—Must be capable of designing exhaust and blower fans. State where last employed and salary expected. Address Vento, care of Heating and Ventilating Magazine.

This is the Valve

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MORGAN-CLARK VACUUM HEATING and FLUSHING SYSTEM

Note the Automatic Self-Cleaning Movable By-Pass

Reduces fuel cost to the minimum. A Flushing System that operates from the engine room, thoroughly cleaning the valves when necessary.

Our 1911 Booklet A takes up Details of Construction and Operation. May we send it to you?

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SMOKELESS COMBUSTION

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50 PER CENT MORE HEAT FOR YOUR MONEY

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We will give you a Surety Bond to guarantee that we can do 50 per cent more work with a pound of coal by our method than is done by any other Power or Heating Boiler. Our Smokeless Combustion fully complies with City Smoke Ordinance.

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Trade Literature

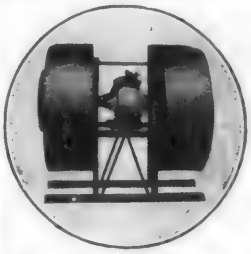
Perfect Ventilation Through Distribution is the title of a new catalogue describing the Knowles mushroom ventilator and air controlling head for theatres, schools, churches, public halls and all auditoriums. These devices are for use in connection with indirect heating and ventilating systems and in their application aid in carrying out the most approved up-to-date methods of securing fresh air. The devices are located underneath the seats and the inflow of warm or cold air can be regulated, it is stated, to the fraction of a cubic foot by means of a valve and locking screw. It may be placed in walls as well as in floors of libraries, museums, etc., where the seats are not stationary. To supply the demand for a ceiling down-draft ventilator for large public rooms, such as banks, exchanges, libraries, etc., where the use of a floor mushroom is not practicable, the catalogue shows a device built on similar lines to the mushroom ventilator, for controlling and distributing the fresh air. The Knowles mushroom ventilators are made in three sizes. The standard type is designed to deliver approximately 4 cu. ft. of fresh air per second. Size 3½ x 6 in. (standard). Pp. 12.

Twenty-four Hours with Sparks Below Atmosphere is an interesting circular that is being sent out by the Iroquois Engineering Co., Chicago, containing illustrations of the devices used with the Sparks system of vacuum heating. The title of the circular is borne out in a chart indicating the pressure carried on a boiler of a heating plant consisting of 27,000 sq. ft. of radiation, equipped with a Sparks system. The line circling the chart and representing the results of a 24-hr. operating period as showing the uniform vacuum maintained, ranging from zero to 12 in. The Sparks vacuum pump, it is stated, will maintain a vacuum on low pressure boilers or on the exhaust or heating mains of a high pressure plant continuallv without cost or aid of outside power. The additional point is made that it is entirely automatic and will operate continually without oiling or attention. Attention is also called to the fact that no royalty is charged for the use of the Sparks system and that it is equally adaptable to large and small plants.

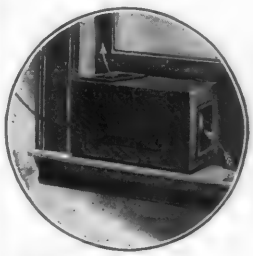
Smokeless Chimneys is the title of a 12-page pamphlet issued by the Furnace Gas Consumer Co., Matteawan, N. Y., describing the Furnace Gas Consumer, a device consisting of a bank of fireclay tubes installed in the space back of the bridge wall underneath the boiler. It is claimed that these tubes become white hot or incandescent and that they serve to reheat the distilled gases and air, so that when the two mingle in the space back of the tubes, complete combustion takes place before the gases again strike the cold surface of the boiler, and there is perfect combustion without formation of smoke or soot. The device, therefore, really consists of a means of heat storage in the furnace, which stores heat when the fire is bright, and utilizes the same heat for the combustion of the gases distilled when fresh fuel is spread over the incandescent fuel bed. Other advantages claimed for this device are that it makes it possible to secure perfect combustion with a smaller excess of air and that the heat absorbing capacity of the boiler is increased, due to the increased absorption by radiation, the white hot tubes radiating into the boiler almost as rapidly as does the incandescent fuel bed, therefore leaving less heat absorption by convection to be performed by the flues.

McCreery Scrubber Type Air Washer is the title of a circular published by the McCreery Engineering Co., Detroit, Mich., illustrating a new form of this company's air washer, known as the scrubber type. The construction is based on the principle which the company has followed that the highest efficiency in air purifying, cooling and humidifying can only be obtained by introducing in the spray chamber broad surfaces over which the air passes and which are kept constantly flooded from the sprays and that spray or mist alone will not prevent the passage of soot and dust. In the scrubber type corrugated metal shelves are arranged immediately behind the sprays, and tilted forward so as to throw the air slightly upward and thus insure air scrubbing contact with the under surfaces of the shelves as well as the upper. The water falling from the lip of each scrubber plate is dashed back by the air against the plate next below, catching and washing down soot and other greasy particles which might otherwise float past the spray nozzles. The scrubber type of air washer is made of galvanized iron and brass alone is used in the construction of the spray heads. The illustration accompanying the circular shows an unusually compact apparatus.

J-M Roofing Salesman, for April, 1912, contains the announcement that the H. W. Johns-Manville Co., New York, is about to build a new industrial town to be known as Manville, N. J. More than 300 acres of land have been bought on the site of what is now known as Finderne. Here will be erected what are destined to be the largest and best-equipped factories in the world for the manufacture of asbestos and magnesia products, including roofings, textiles, packings, insulation materials and other J-M products. The company is now erecting another large factory in the Claremont section of Jersey City for the manufacture of cork insulating materials.



Our Double Blower built in all sizes. Capacity up to 8,000,000 cubic feet of air per hour each.



Window Ventilators made in five sizes, changing from 3000 to 21,176 cu. ft. of air per hour.

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GUARANTEED to be the only positive System of Ventilation on the market. Extracting from the building or room all the foul air, replacing it at same time with the same amount of pure air gathered from the outside.

Positively correct Ventilation of School Buildings a Specialty.

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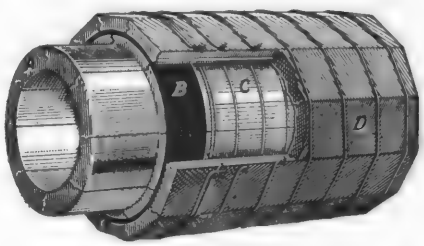
Reliable Agents Wanted in All Unoccupied Territory

CYPRESS UNDERGROUND STEAM PIPE COVERING



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B—Asphaltum Packing
C—Dead Air Space
D—1 inch Thick Outer Shell

Gulf Cypress, the wood eternal, will not rot under wet and dry conditions. Wound with Heavy Galvanized Wire.

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A. WYCKOFF & SON CO., Elmira, N. Y.

These two plants, together with the company's asphalt refineries at South Amboy, N. J., will give employment to several thousand men.

Valve World for April, 1912, published by the Crane Co., Chicago, is a memorial number for the late Richard T. Crane, president and founder of the company, who died January 8, last. The issue is remarkable for the completeness with which the career of Mr. Crane is reviewed and for the artistic excellence of its printed pages. The life of Mr. Crane is told under separate headings, as "ironmaster," "a real builder," "a real friend of real education," "a maker of men," "the employer" and "the man." Much of the matter is of historical interest to the trade generally as Mr. Crane's life practically spanned the manufacture of pipe and fittings in this country. It is altogether a notable publication.

BOOKS ON HEATING AND VENTILATION

Mechanical Equipment of Federal Buildings Under Control of the Treasury Department. By Nelson S. Thompson, chief mechanical and electrical engineer, office of the supervising architect. Second edition, revised and enlarged. Contains the basic data used in the design of the mechanical and electrical equipment of Federal buildings under the control of the Treasury Department. Also contains data for approximating the cost of the various parts of the work. The book takes in heating and ventilation, plumbing, stationary and portable vacuum cleaning plants, engines and generators, motors and controlling apparatus, forced systems of hot water heating, commercial practice in factory heating, etc., and other valuable data. Cloth, $2.00.

Central Station Heating. By Byron T. Gifford. This work presents the most advanced practice in central station heating, both steam and hot water, and is an invaluable guide, not only to the engineer, but to municipalities and public service commissions where district heating is being, or will be, used. 208 pages, with 42 figures, including 50 pages of miscellaneous engineering data. Size 6 x 9½ in., bound in flexible leather. Price, $4.00.

Mechanics of Heating and Ventilating. By Konrad Meier. Including a series of ten charts containing data relating to the flow of water, steam and air, collected by Mr. Meier during an experience of 26 years in heating and ventilating work, both in this country and abroad. Each of the charts replaces a series of tables on the subject, giving at a glance the result of a calculation from any combination of factors. 161 pages, illustrated, with ten large charts. Size 6 x 9 in. Price, $5.00. Separate sets of charts, printed on cloth, with lines in different colors and mounted on boards. Single charts, $1.50. Sets of ten charts, $15.00.

Heating and Ventilating Buildings, a standard manual for heating engineers and architects. By Prof. R. C. Carpenter. Fifth edition, largely rewritten. 577 pages, 277 illustrations, 8vo, cloth, $4.00.

Handbook for Heating and Ventilating Engineers. By Prof. James D. Hoffman and Benjamin F. Raber. The latest book on this subject. Unusually comprehensive. 320 pages, with 45-page appendix. Size 4¼x6¾ in., bound in flexible leather. Price, $3.50.

Questions and Answers on the Practice and Theory of Steam and Hot-Water Heating. By R. M. Starbuck. Illustrated. $1.00.

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